TRANSACTIONS

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TRANSACTIONS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION

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PREFACE

THE AMERICAN FOUNDRYMEN'S ASSOCIATION IS GREATLY INDEBTED TO THE FOUNDRY FOR SETTING THE TYPE OF THE MATTER CONTAINED HEREIN WITHOUT COMPENSATION SO FAR AS IT IS USED IN ITS OWN PAGES. THIS HAS RESULTED IN A CONSIDERABLE SAVING TO THE ASSOCIATION, AND ENABLES IT TO DEVOTE THE FUNDS TO OTHER USEFUL ENDS.

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THE UNIVERSAL SYSTEM OF MACHINE MOLDING

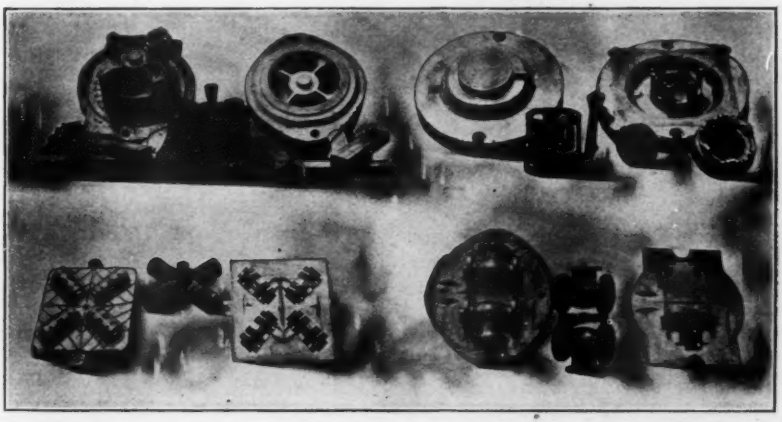
By Monsieur E. Ronceray, Paris

It is perhaps a great temerity for an inhabitant of the old continent to dare to come over here and talk to you about an improvement in machine molding.

You have the reputation all over the world of being far ahead of we Europeans, and you are so alive and quick to improve your methods, that I have been considered somewhat of a fool, when advising my friends, that in May, 1907, I would cross the Atlantic for the simple purpose of exhibiting our Universal molding machines in operation at the American Foundrymen's Association convention, with the hope of arousing interest therein to some extent.

I have heard that, although you are quick to improve your methods, you also welcome all new things, provided they are good, and I have been told that mine are good. You have perhaps read, in some of your technical papers, such as *American Machinist*, The Foundry, *Machinery*, and other periodicals, both American or foreign, contributions about what we have called "The Universal System of Machine Molding."

The Foundry, among others, in its December issue, stated that the way we worked the problem of machine molding differed from your ways, but that when the same task is given to several bright individuals to perform, each is sure to have some good points in his method of solving the problem. I want to thank the editor for this kind appreciation, but perhaps, he might have added that, if the solution of the problem is different, it is be-



Figs. 1, 2, 3 and 4—Extensive and Varied Use of Stripping Plates

Nine Stripping Plates and Four Plugs in the Two Bottom Plates

Another Type of Stripping Plate

Stripping Plate which is also Part of Pattern and Core Print

Plain Stripping Plate

cause the conditions were also different.

In America, you have a market, not only larger than the French, English or German markets, separately, but even larger than all the European markets combined. Consequently, when we Frenchmen have an opportunity of making one dynamo, you can make a hundred; where we make 10 gas engines, you make 1,000; and where we make 100 castings, you make 10,000. This is enough to show how different are the problems we have to solve, even when they appear to be the same.

tomobile industry. Up to the present time, in France, this industry has not been standardized, and consequently the castings are the most intricate that can be found. Furthermore these castings are always wanted in such a hurry that it seems as if the automobile manufacturer wants to get his orders through at the same speed that he runs his cars. Consequently, the orders being small, we have had to make our pattern plates quickly and cheaply, and to make them from the ordinary wooden patterns for any intricate casting. After that we had to design ma-

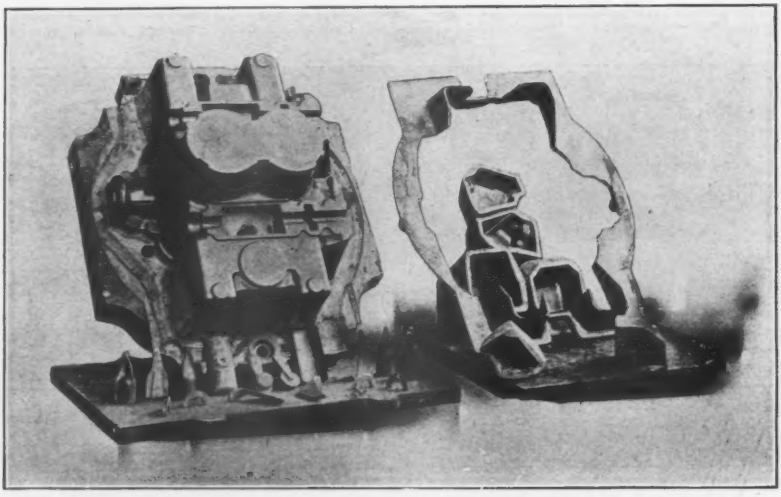


FIG. 5.—EXTENSIVE USE OF LOOSE PARTS ON STRIPPING PLATES

Receiving such large orders, you do not hesitate to spend money on pattern plates and special molding machines, the expense per casting being reduced to a trifle on account of the quantity of castings you have had to make. You have gone as far as to design the castings, and make the patterns to suit the molding machines. In France, we have had to deal with small orders, with patterns made for molding by hand, and the castings are very often designed by draftsmen who have never seen a mold in their lives.

We have had to find something to meet the demands of our growing au-

chines for using these pattern plates and making castings from them.

There is no need of telling you that the problem was rather difficult. Nevertheless, after a heavy expense, time and with the help of several bright foundrymen and mechanics, it has been solved, and I am only too pleased to present to you today the results of our efforts, in the hope that they will be of some interest.

The pattern plates we make, which are covered by several patents, are of different types, or more definitely, are a combination of different systems. We will examine them quickly, and, if any

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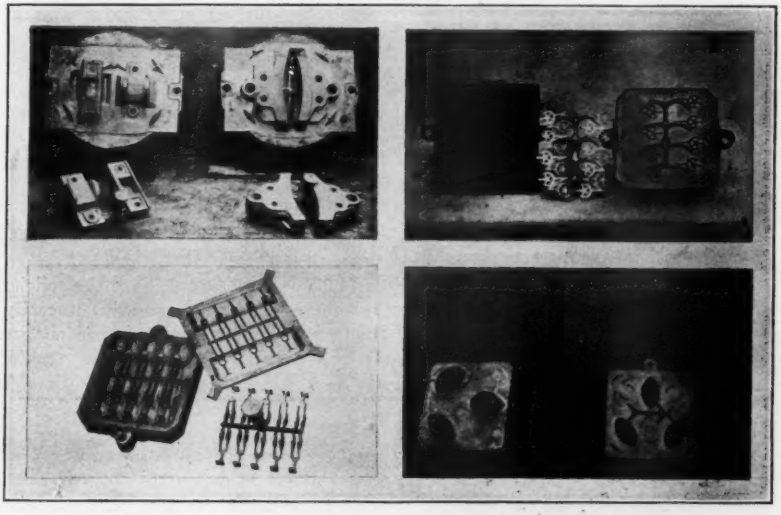
further information is desired, I shall be glad to give it.

The whole system has been devised with a view of making pattern plates and stripping plates in the foundry, without the help of the machine shop. There is no need of mentioning to an assembly of founders the trouble and delay involved in obtaining a pattern or a pattern plate from a machine shop, and when after a lot of difficulties, and wasted time, it is secured, in most cases it is useless.

To make a good pattern plate it is necessary for one to be a good molder, a good fitter and a good patternmaker, which accomplishments are rather difficult to find in the same man. Our processes have the advantage of obviating these difficulties and result in a considerable reduction in the cost of pattern plates. Our patterns are adaptable for any castings required by the trade, provided 50 castings or more are made from the same pattern.

It is needless to emphasize that these results will widen the field of machine molding considerably, which has up to the present been confined to a definite class of work. According to my understanding of the situation, I claim that if 10 per cent of the total tonnage of castings, under 500 pounds have been machine molded up to the present, 50 per cent at least, will be molded in the future by the use of these new methods. One of the main points is the method of making stripping plates.

Every founder knows the numerous advantages of stripping plates and also the various schemes that have been invented to do away with them, on account of their high cost and the impossibility of adapting them to crooked joints or intricate castings. In spite of the ingenuity spent here in power ramming machines, hand stripping plate machines still have a good reputation, and are certainly capable of turning out fine castings. The way we make stripping plates enables the founder to use them in profusion whenever there is the slightest danger of the sand breaking, or, as we express it in French, he uses the stripping plates—"a toutes les sauces." The result is that we are absolutely certain of getting a good mold at each ramming, as far as this side of the question is concerned.



FIGS. 6, 7, 8 AND 9—EXTENSIVE USE OF PATTERN PLATES

Figs. 1, 2, 3 and 4 illustrate clearly

to what an extent we use stripping plates, and an inspection of them will quickly show that no fitting has been done. These stripping plates are usually made of a non-contracting metal, but in special cases they can readily be made of cast iron. Let me call your attention to Fig. 5, which illustrates an instance with which loose parts, in fact, a considerable number of them, can be used on certain plates. In this case not less than 25 stripping plates are used and very often we take twice as many.

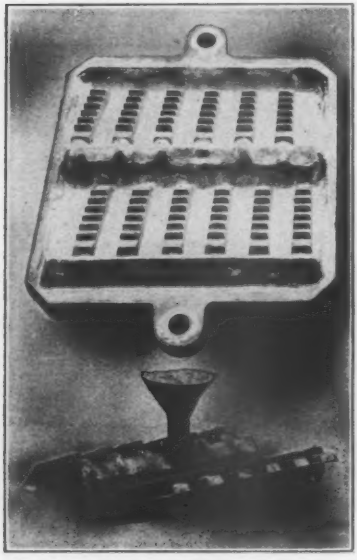


FIG. 10—CASTINGS SET EDGE TO EDGE TO ECONOMIZE SPACE

When the casting is not very large, and is of such shape as to allow it, we use reversible plates, disposed with top and bottom of the same pattern, side by side, so that two flasks rammed on the same pattern plate, constitute a complete mold. Similar work has previously been done by setting half patterns on a plate, but in our process, we obtain it simply by molding, even if the joint is very crooked, and the pattern plates thus obtained are always absolutely accurate. Figs. 6, 7, 8 and 9 show a few examples of this arrangement which has proven to be most useful in a number of cases.

A peculiarity of this reversible system is that, when a side of the casting is flat, or almost flat, a great saving in space is effected by setting castings edge to edge. Fig. 10 shows a good example of this arrangement which effects a saving of 30 per cent of space in certain cases.

A special application of the reversible process is its use for making what we have called "Cliche." The cliche is a small reversible pattern plate, entirely metallic, of constant width but of variable length, containing as many of the articles to be molded, as can be inserted in its surface. These cliches, which are readily obtained, are inserted in a special frame called a "cliche table," the number of them varying according to their length, and this table itself forms a reversible multiple pattern plate, variable at will in its composition.

The main advantage of the cliche system is that the founder can easily remove and replace any of the cliches from the cliche table, and never make more molds than are required of any pattern ordered, which is an important saving. The cliches are kept in store and are always ready for any repeat order of the same article.

It is necessary to add that the time of manufacturing a pattern plate, by these processes, varies from one or two hours for a cliche, to several days for the most complicated plates. Perhaps, it may be well to state that the pattern plate, as we have conceived it, is a strongly built contrivance, strong not only by reason of its elements, but more especially by its design. It is composed, as a rule, of a base formed by an iron-frame, filled with plaster, upon which are set the patterns composed of a thin shell of white metal filled with plaster, on which they rest during the ramming action. It is evident that it is quite different from the pattern plates and stripping plates known in America.

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I will now discuss the machines we have designed to complete this line of new devices. We, of course, can use ordinary pattern plates, and with slight alterations, even vibrating pattern plates. But our machines give their maximum results with our system of pattern plates and stripping plates.

Makers of molding machines have numerous styles, and in each style a number of sizes. It is generally claimed to be a talking point. We, on the contrary, except a few special machines only used for very special cases, have only two styles of machines and each style is limited in sizes. Each of our machines can handle all sorts of castings up to its maximum capacity, from the most simple up to the most intricate, using flasks of many different sizes and shapes up to the maximum capacity, which no other machine on the market has been able to accomplish up to the present. This is the reason we have called our machine Universal, and in our opinion, it is a great point in our favor. In fact we consider that this small number of machines is the best proof that the system is universal, and I have no hesitancy in saying, covers a much wider field than the many machine built up to the present.

The universal machines are made standard and swinging, the former in six sizes ranging from 10 x 10 inch flasks up to 5 x 4 foot flasks and even larger. The latter in four sizes covering the same range making 10 sizes in all.

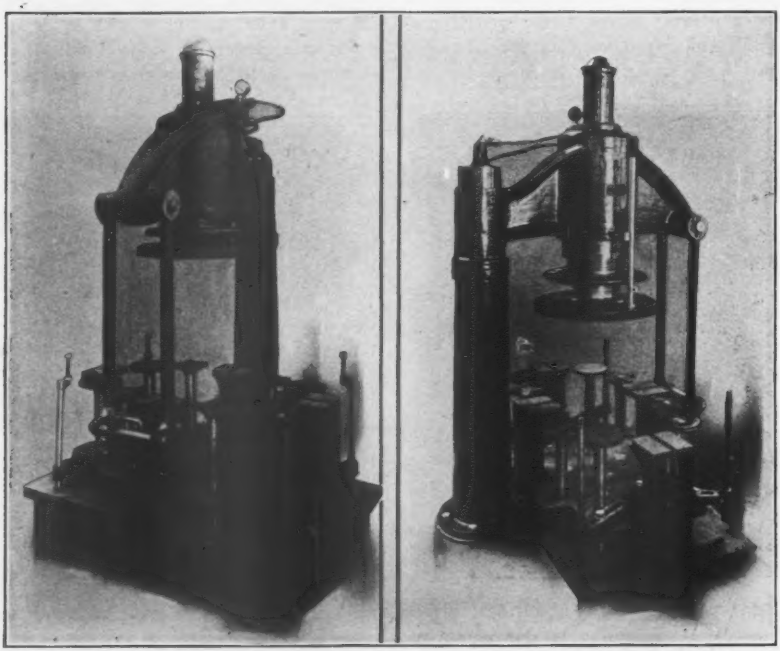
To operate our machines the agent selected is hydraulic power, instead of compressed air generally used here. This agent has been chosen after careful examination, and was not left to chance. I fail to agree with most of your manufacturers, who hold that compressed air is necessary for machine molding, and I will explain my reasons for this. Compressed air is usually available at a pressure of 80 to 100 pounds per square inch. This low pressure leads to the adoption of a big cylinder to obtain sufficient pressure to ram the mold, but as a rule, the static pressure, even with such big cylinders, is not sufficient, and it is then necessary to give blows. You have all experienced this action which is much like the one of a steam hammer, and you know, how destructive it is, both to the pattern plates and the machines.

Regarding the drawing of the pat-

FIG. 11—MOLDING MACHINE WITH SWINGING HEAD

FIG. 12—AUTOMATIC SAND DISTRIBUTOR

tern, compressed air being an elastic fluid, is not at all adapted to this kind of work and to properly perform this operation it has been found necessary, either to draw the pattern by hand or to use what I have no hesitation in calling very ingenious devices but which however are somewhat complicated. Hydraulic pressure can be obtained high enough to use static pressure for ramming with reasonable



FIGS. 13 AND 14—MACHINE DESIGNED FOR LARGE WORK

sizes of pistons, and I consider this a great advantage.

You not only get the exact pressure necessary by the use of a gage and so have it under perfect control, but also by simple arrangements, you can obtain more or less pressure as required, hard in some places and soft in others, which is necessary to obtain good work.

For the drawing of the pattern, the gentle and steady motion of hydraulic power is exactly what is necessary and permits the use of time saving

devices, to which I will refer. Another important point is the power consumed. As an average compressed air machine requires about four horsepower, our machines and arrangements accomplish the same work with 1-5 horsepower or 20 times less.

One may advance an objection by saying that water may freeze in cold weather; in spite of the fact that all modern foundries are heated and a lot of hydraulic appliances are used in metallurgy without trouble. I wish to call your attention to the fact that nothing is simpler than making a return to the tank and then using a non-freezing mixture, such as alcohol or glycerine, in the water to prevent it from freezing.

The piping generally used is very small; it ranges from three-eighths inch inside diameter up to one inch for very large plants, but the latter is seldom used.

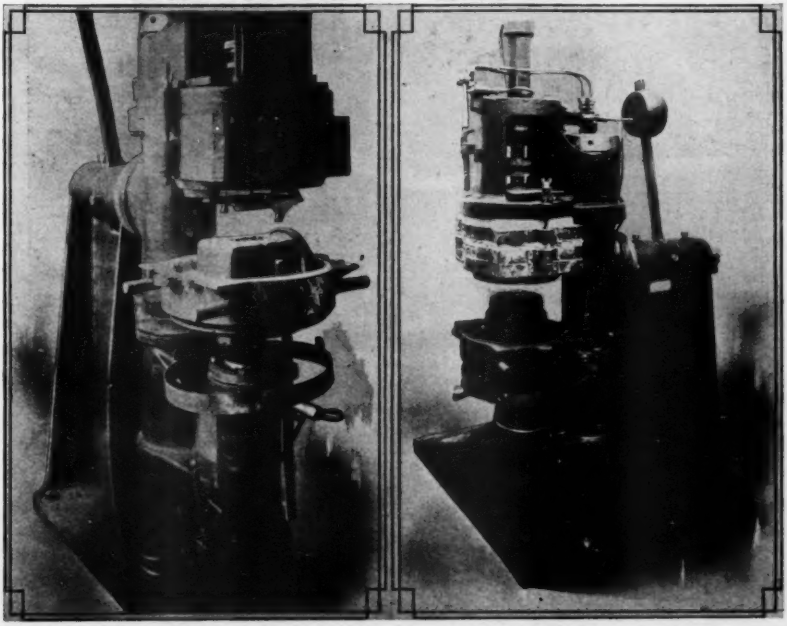
Our standard machines are divided

into two classes, designated as A and M. The difference is only in the detail of the table.

The class A molding machine generally consists of a box or pedestal, the top of which is a table on which the pattern plate is fixed. A swinging beam pivoted on the back column, carries the hydraulic piston for ramming the sand, and a moveable hook placed at the other end of the beam, allows it to be fixed in the right position for ramming. The height available above the table can be adjusted by a telescopic screw, reducing the stroke to its minimum in each case and then saving water and time, while striking off sand is avoided owing to the perfectly flat surfaces so obtained. Inside the box is a vertical hydraulic ram carrying a moveable table. This ram is provided for drawing the mold from the pattern plate after ramming. For this purpose, the table carries four adjustable brackets holding four vertical rods, which work outside of the body of the machine, and engage the corners of the flasks, or of the stripping plates, so that an absolutely true lift is obtained.

FIG. 15—SWINGING MACHINE

In a few special cases, where long cores, gears, etc., have to be dealt with



FIGS. 16 AND 17—MACHINE FOR SMALL WORK

we recommend the installation of the machine with a double ramming device, which insures an equal pressure, being exerted over the whole length of the core or gives an additional ramming in the weak parts of the mold. The swinging beam has the advantage of leaving the access to the flask entirely free for the operator to move around which is shown in Fig. 11.

Recently the machines have been fitted with a special treadle arrangement for drawing the flask.

The cinematograph pictures of the machine in operation enable you to follow the assembling machine, which makes what we call "Mottes", in a much better and accurate way than snap flasks.

A useful addition to such a quick machine is the automatic sand distributer, Fig. 12, which consists of a hopper in which the sand is fed by a mechanical device, depending on the general arrangement of the foundry and under which a swinging box is filled with sand and emptied when above the flasks. The opening and closing of bottom of the hopper and box are obtained by a simple motion backward and forward of a lever worked by the man operating the machine. This device saves all shoveling and consequently considerably increases the output. The cinematograph shows you the speed with which molds can be produced.

FIG. 18—LARGE SPECIAL MOLDING MACHINE

Class M machines, Figs. 13 and 14

have been designed specially for large work, as mine shafts and tunnel segments, truck bolsters, four and six cylinder automobile casings, large valves, etc. The chief difference as compared with the other machines is in the adaptability of the table to the requirements of the castings to be made.

With the standard universal machines previously described practically all molds can be produced, but, when heavy pockets of sand have to be lifted, the use of gaggers becomes a necessity. This renders the ramming uncertain and tedious, and the use of the swinging universal machine overcomes this difficulty. These machines are also very useful when the sand has no binding power, especially for the production of drags, which, after their ramming on the machine, are turned over into their pouring position. In their main points, the swinging machines are very much like our standard types, only having a longer ramming stroke and a shorter drawing stroke; but they are pivoted on a horizontal axle which is placed about the center of gravity of the machine, when loaded with the mold.

The operation of these machines is similar to that of the standard machines, but when the mold is under pressure, the whole machine, with pattern plate and mold, is revolved 180°, to draw the mold on its base, as shown in Fig. 15.

The swinging machines can, occasionally, be used as standard machines, and, in that case their operation is exactly the same as the standard type. When used as swinging machines, their operation is decidedly different. The ramming piston is not only used for ramming, but also for drawing the mold, and the function of the opposite piston is to help the starting of the sand at the beginning of the drawing operation and then stop, when the mold is out of danger. In fact, the mold is at first supported by the two pistons, the ramming piston carrying the ramming plate, and very often a follow board and the drawing piston, to which are attached our usual stripping plates and stools, instead of being loose, as in the case of the standard machines. At a certain point the drawing piston together with its attached stripping plates and stools is stopped while the ramming piston continues lowering down, thus accomplishing the drawing of the mold.

I confess that when we conceived the idea of this machine, we had grave doubts as to its success, and decided to make at first a very small machine. After a good many alterations we were successful, and with practice all doubts were dispelled and we have now made very heavy machines of this style for many classes of work.

Figs. 16 and 17 illustrate a small machine for 14-inch flasks. The first view shows the molding of a pot which is a very simple job, but which is accomplished very rapidly. Fig. 17 shows the molding of the drag of an open railway axle journal box (German type) together with all cores. This is interesting as the output is not much smaller than when the pots are made.

Fig. 18 shows a very large special machine made for cotton cording machinery.

A NEW METHOD OF PREPARING FOUNDRY SAND

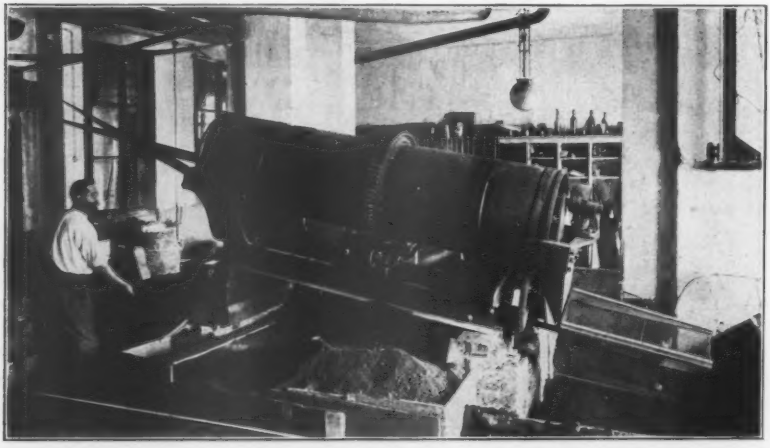
By Monsieur E. Ronceray, Paris

Molding sand is composed of grains of silica, of various sizes and shapes, and of alumina or clay, which is generally in a very fine state. Besides these ingredients, molding sand contains impurities such as oxide of iron, lime (sulphate or carbonate), magnesia, etc.

The ideal sand should be composed exclusively of grains of silica, with a coating of clay as thin, but continuous as possible. Such a sand would be very refractory and very porous if the grains of silica were of convenient size and the coating of clay thin enough.

Let us take commercially pure silica and mix a certain amount of clay with it, and obtain, as near as possible, a mixture like foundry sand. If we take a handful of this mixture it is easy to see that it has no consistency, no bond.

Let us rub it by hand, for 2 minutes, and take a sample, then repeat the operation several times. If we compare these samples, it is easy to see that with more rubbing, we get more bond, and, after a certain time, we arrive at a condition in which the bond will cease to increase. By this operation each grain of silica receives a better coating of clay. All this has been accomplished without the common, tedious work of preparing sand by drying, pulverizing, mixing, etc., and, this very simple experiment gives us a new method of obtaining good molding sand, even if good pure deposits are not at hand. Silica sand is found nearly everywhere, and there is no difficulty in finding a clay convenient for this purpose. To obtain the proper result, the rubbing must be perfect, and it is to put this idea in practice, that we have designed our automatic sand mixing and rubbing machine.



Continuous Sand Mixer

This machine uses wet sand as it comes from the quarry, without requiring any previous drying, mixing or screening. The quality of sand obtained is always alike, and is delivered by the machine ready for

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use without any additional handling.

The principle of the machine is new. A barrel slightly inclined is mounted on rollers as shown in the accompanying illustration, and by means of a suitable drive is caused to revolve slowly. The barrel is divided into two chambers, the first one receiving the sand after it has been roughly mixed and moistened on the floor. It is then thoroughly mixed in this chamber by the rotation of the barrel and passes into the second chamber. There several lines of rollers of different sizes take the sand, rub and work it. A scraper which is kept in contact with the barrel by a weight detaches the sand which adheres to the sides. It then falls between the rollers and is worked over and over again.

The sand then passes slowly to the end of the machine where, after passing through a wire screen, it falls to the floor finished and ready for use. In some cases, we have found it an advantage to use a small disintegrator before screening. The sand obtained is then very light and porous.

SHOP KINKS OR SHORT CUTS, AND DONT'S

By the Cleveland Club of Associated Patternmaker Foremen

In no trade, more than in patternmaking, does the individual have the opportunity to develop his original ideas and carry them to a successful issue, yet there are many patternmakers that are content to follow precedent and do certain jobs today in a certain way just because they saw some one else do a similar job in like manner years ago, regardless of the fact that a shorter method may be found, if sought.

It is the object of this paper to keep the patternmaker thinking along new lines, to show this by a few examples, and to impress it particularly by a series of "don'ts."

For instance, we may say, "Don't forget those simple geometrical problems that you learned years ago while at school (we used the term years ago advisedly) that you may need today." But don't always follow the roundabout way of working that may have been taught you by the professor. How many patternmakers waste time and brain power, for instance, struggling with the simple problem of striking the ellipse.

Striking an Ellipse.

Various and curious have been the devices contrived for delineating the contour of an ellipse, and the fact does not seem to be universally known that the true way is the simplest. Fig. 1 shows how this can be done with the ordinary steel square, or in fact almost anything that is handy, having two of its edges at right angles, and a thin stick, about ¼ inch x ½ inch, a little longer than one-half the major diameter of the ellipse.

Take the pieces on which you wish to lay out the ellipse, mark off the center lines, also the major and minor diameters, transfer the lengths of the semi-major and semi-minor diameters to the stick, driving in two fine brads at these points. Next, place the square on the center lines, the intersecting outer edges at the center of the ellipse, drive in three small brads as shown at b1, b2, and b3, which will secure the square in position. Then, placing the stick in position the two brads will project through the under side slightly less than the thickness of the square bearing against the two outer edges, move carefully to the right and the tracer will mark out one-quarter of an accurate ellipse. The draughtsman can do the same thing on his drawing

by utilizing his set square or triangle and thumb tacks, two pins and sliver.

Different Application.

Fig. 2 illustrates the same principle, the application being slightly different. Take a piece of wood, large enough to make one-quarter of the ellipse, trim off one end square with one edge, place the end against the edge of another piece of the same thickness straight on one edge, and brad them lightly to the table. Take a narrow strip and drive two brads through it as shown in Fig. 1. Placing the tracer at the end of the stick, draw to the right, allowing the brads to slide closely on the inside edges of the two

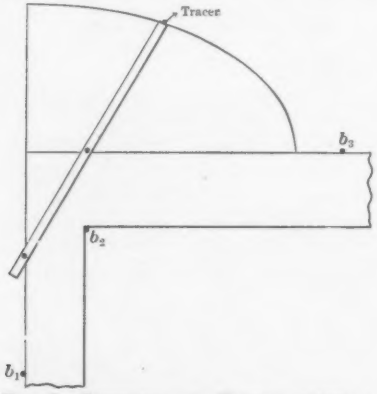

FIG. 1—STRIKING AN ELLIPSE WITH A SQUARE AND TRACING BAR

pieces of stick, and the result is the same as secured by the first method; by simply reversing the pieces you can get the other parts, or you can cut out the quarter and use it as a templet. It is exactly the same as an ellipsograph and just as accurate; but how often do you rub against a patternmaker with one in his kit? Some are minus other things more essential than an ellipsograph, but a few brads and a stick are always at hand.

Fig. 3 is an illustration of turning up in the lathe an elliptical valve which will fit accurately in a circular pipe at an angle of 45 degrees. Having the diameter of the pipe, which is the minor diameter of the ellipse, ascertain the major or long diameter by laying out the angle; cut out of a piece of stock an approximate ellipse the required thickness of the valve, leaving sufficient stock on the edges for turning off; then take two pieces large enough to take in the butterfly and tail stock centers and of sufficient length and rigidity, fasten them securely in the center of the piece for the pattern, at an angle of 45 degrees, center the ends and proceed to turn. It is not as difficult as it looks, the dotted lines in the sketch showing the exact contour of the edge as the piece revolves, and with a modern screw feed lathe, would be easy. This is a very quick way and will insure a perfect fit in the pipe.

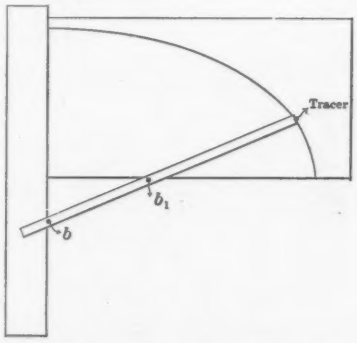

FIG. 2—STRIKING AN ELLIPSE WITH TWO PIECES OF WOOD AND A TRACING BAR

Fig. 4 is a fairly good approximate layout of an ellipse by the divider route, a b is the major and c d the minor axis of an ellipse. Space off b e equal to the semi-minor axis c o, using a e as the radius for the arc at each end of the minor axis. Bisect e o at f and space off eg equal to ef and use gb as radius for the arc at each end of the major axis. This is a very good approximate method, very nearly approaching perfection when the difference in length of each axis is not great.

Arcs of Circles of Large Diameter.

To strike the true arc of a circle whose center is inaccessible, or whose radius is so large that it is not practicable to strike it by means of a long

trammel or rod, there is nothing to compare with a steel tape, using a chalk line for the radial lines. Fig. 5 is illustrative of a method which is accurate and also easily applied. It represents the three curves necessary for the layout of a bend pipe of a large radius. Having the chord line it is first necessary to find the versin or the rise in the center, which may be done by using the following formula:

$$\frac{d - \sqrt{d^2 - c^2}}{2} = \text{versin.}$$

Reducing this to shop lingo, it reads from the square of the diameter subtract the square of chord, then extract the square root of the remainder; subtract that from the diameter and divide by two. The answer is the rise or versin.

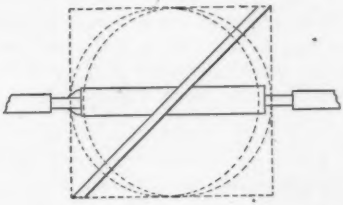

FIG. 3—TURNING AN ELLIPTICAL VALVE

Next it is in order to cut a board in the form of a triangle, the base being the chord line as shown at a b, the apex at c. You will note from the sketch that it is necessary to extend the ends of the triangle at a and b, which is done by making the base line one inch below the chord line, parallel with it. In order to strike the three curves from the one triangle, it will be necessary to screw onto this piece a narrow strip in the center at right angles to the base line, as shown at c, its length equal to the diameter of the pipe. Having laid out the center chord line, place the triangle in position, driving into the table or layout board three brads as shown at b1, b2, and b3. Place the tracer at either point as marked and move to the right or left, taking care that the base of the triangle remains in contact with brad marked b2, and if to the right with brad b3, or if to the left with b2 and b1. The tracing point will delineate the true curve, and you will not have to go out on the street or require the area of a 10-acre lot to do it in, as we are informed has been necessary in some cases.

Advice for the Patternmaker.

To the patternmaker, we would say, don't be a shop knocker, but make the best use of the tools at hand; remember that only a very few shops are up-to-date.

When speaking of an up-to-date shop, most of our mechanics of today imagine that a shop of this kind must be equipped with a lot of new machines that most of them have never

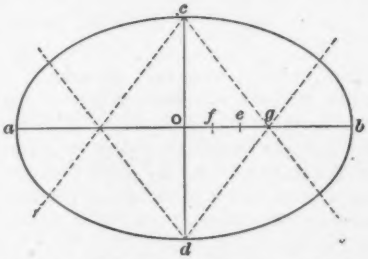

FIG. 4—APPROXIMATE METHOD OF DRAWING AN ELLIPSE

seen, or that take an age to learn to operate.

It never will occur to the workman that he himself should be an up-to-date mechanic, with new ideas, and that he should add to that ancient shop which has, perhaps, for years buttered his bread to his satisfaction. Instead, he often curses the old place as not being up-to-date, and characterizes his employer as being too tight-fisted or too selfish.

The old saying is that there is no ocean so deep but that it has a bottom. The failure of the old shop in not putting out work to compete with others is not always due to the employer's selfishness. But getting down to the bottom is due to the workmen employed in such a place, for can you find such a shop-knocker that will even try to make the best use out of that machine which he already has?

Old machines are not always scrap or useless, just because there is a more modern one on the market; a little study given to the old machine will certainly improve it. For instance, take an old cross-cut saw table in running condition in a pattern shop where the table has not been graduated so

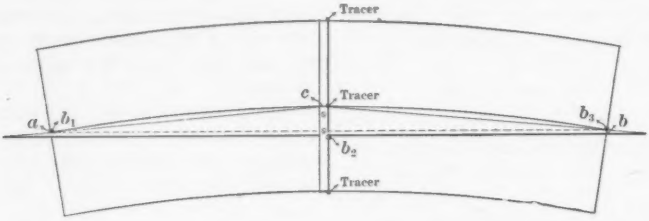

FIG. 5.—DRAWING AN ARC

that octagon, hexagon or miter or other degrees can be cut on it, by placing the guide in position. This table is easily improved and made equal to the modern ones by simply applying a piece of board on which the segment of 90 degrees is laid out as shown in Fig. 6.

To correctly make this board is simple. Take a board jointed and of parallel thickness the full width of the table, and place it at the left of your saw; screw or nail strip D as shown in Fig. 6; place in slot as shown in Fig. 7 and rip off to width. This done, take it to the bench and square from the ripped side and lay out the segment as shown in B, with the center a convenient distance from edge so that guide C can be seen crossing it.

This guide has two pins to steady it in different positions, without interfering with the edges; the one far enough in from the center, so as to allow a number of holes on the different degrees in board B.

Place this guide piece on the different degrees on board B and bore from guide C through board B. Put dowel pins in the guide C and the improvement is complete for any straight work to be cut to any angle.

The work is not always of a straight nature and curves must be cut on angles of different degrees, as segments for rings, sometimes in quarters, sixths, eighths, twelfths, or any part of a circle. This is very hard for most workmen, and many of them waste more time in trying to butt these together than it should take to complete the work.

With a simple improvement to our first device, this can be done very easily in about one-tenth the time required for any other way and all hard

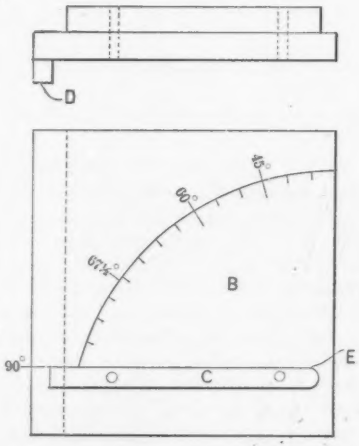

FIG. 6—GUIDE BOARD FOR THE SAW

labor will be avoided and a better joint will be made.

Another Improvement.

Improvement No. 2 can easily be added at a very small cost to the employer. This consists of a straight and parallel piece as shown in Fig. 8, placed on the device shown in Fig. 6

at the desired degree. It is easily made by the following method:

Take a straight and parallel piece as shown at I, Fig. 8, of any thickness, and rip a tongue of about 1 inch on edge. Take two pieces marked F and H, Fig. 8, of the same thickness about 4 inches long and 2 inches wide, and groove to take tongue of piece I, cutting and fastening piece H tightly to

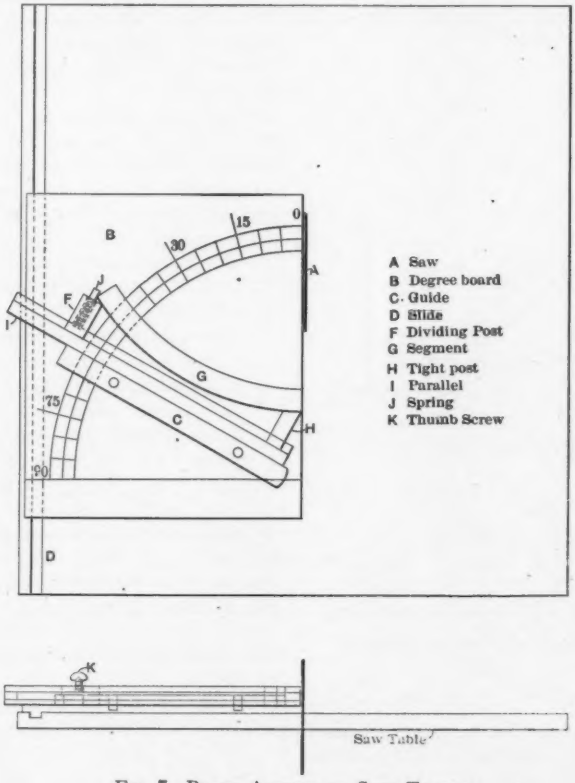

FIG. 7—BOARD APPLIED TO SAW TABLE

piece I, as shown; then in F place an old style window spring by boring a hole at J in F, as shown. Get a thumb screw K and nut to fit it, cut a notch in the groove to receive the nut, and bore a hole that the thumbscrew will take the nut in the notch and tighten down on the tongue in I.

In using it, the segment is first sawed on the band saw to the size required. A chord is found corresponding to the number of segments wanted for the circle; the length of the chord is made the distance between the spring piston J in F and the cutting point of saw or face of post H. The first cut of the proper degree is made with the spring drawn in with the segment as shown in Fig. 8. The other end or length is cut by bumping the end already cut against the spring piston as shown in Fig. 9.

Cheap Sanders.

Another very useful labor saving device for this curved work is a cheap sander, which can also be rigged by the employe without great cost, as the lathe in the shop can be used.

Take the extra face plate, screw a disc to it, true up the face and turn

to about 10 inches diameter; then get a sheet of coarse sandpaper and four pieces of leather or rubber about ¼ of an inch square; place your paper on the disc, first dampening slightly on the back, and bend the corners over the edge of the disc and tack it on through the leather or rubber. By placing a block on the bed within ¼ of an inch of the disc, and just to the center of head of lathe, so that it can easily be removed and also tilted, it is ready for work.

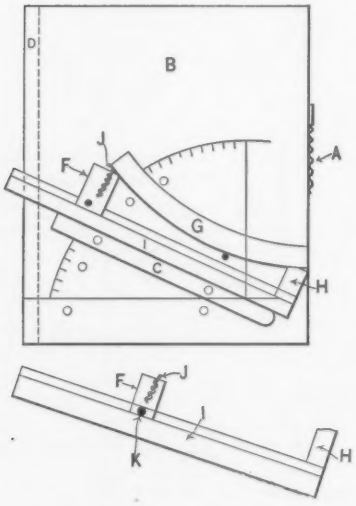

FIG. 8—ATTACHMENT FOR SEGMENT WORK

This rigging can be used to good advantage for making a number of tail prints, discs, segments, round prints and small flat surfaces.

Band Sawing to the Line.

Don't start your job until you have it well in mind, or you may strike a snag later on.

Don't proceed with the pattern without noting the metal of which it is to be cast.

Don't fail to inquire whether the grade of pattern is temporary, medium or standard.

Don't forget that the art of quick pattern making lies in knowing where to slight it,—but

Don't form the habit of slighting everything. The man that can work according to his job is a valuable man.

Don't trouble the boss with fool questions. He has troubles of his own, besides you may expose your ignorance at the same time.

Don't try to get along without really necessary information on the job at hand, which the boss may have neglected to give you.

Don't make unnecessary layouts of work.

Don't take time to lay out a job, then not use the layout; properly used, it will save time on the job.

Don't fail to study economy both of material and time; both cost your employer money.

Don't miss checking up all dimensions on the drawing before proceeding with pattern.

Don't make a pattern without knowing how it is to be molded, simply because the old man told you to do so.

Don't accept your first inspiration as to the molding and construction of a pattern; try and think out another way.

Don't start a job you don't see through, expecting to get an inspiration as you go along. This idea wears out the floor between your bench and the old man's desk.

Don't construct large patterns without provisions for handling, shipping or storing.

Don't be stingy with your core prints.

Don't be afraid that well defined center lines will spoil the looks of your job. They will look good to the checker, and to the lad who may have to change the job later.

Don't fail to put center lines on your core boxes, as well as your patterns. A pattern like bread that is cast on the waters, is seen again after many days, and it may be up to you to change it.

Don't look as pleasant as a calf's father, when the boss gives you a disagreeable job. Do it cheerfully, and

if you think he is rubbing it in, you can always quit; and if he really is, you had better.

Don't pick out all the snaps for yourself, when you have help on a job. However good you may be—

Don't forget there are others.

Don't despise the help of the apprentice on the job. He did not come in simply to learn to varnish, so let him do things. If he falls down, pick him up, and—

Don't forget you had your troubles, and when you are a has been, he may help you.

Don't think that you know it all; there are other men that know a little.

Don't do by hand that which the machine should do, but you—

Don't have to wait your turn at the band-saw to cut off a toothpick.

Don't fail to study your machines and how to get the most out of them, but—

Don't take liberties or long chances with the jointer, especially when the knives are dull; better a few shavings round your vise than a crippled mitt.

Don't take long chances on the lathe, remember the adage, "An ounce of prevention is worth a pound of cure."

Don't waste time setting bevels for standard cuts that are arranged for on the saw table or trimmer. A little mental calculation and the indicator is better.

Don't think because you see a circle on the drawing that the work must be done in the lathe; other pieces fit sometimes, and

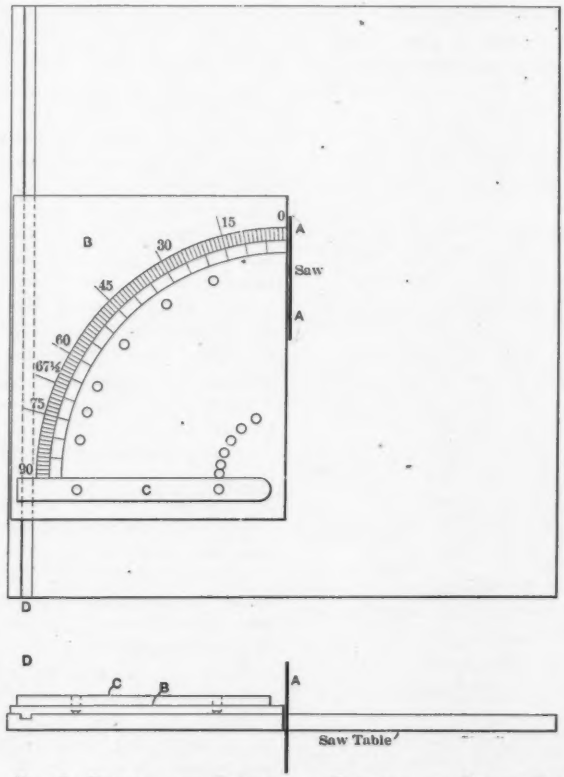

FIG. 9—DEVICE WITH SEGMENT IN POSITION FOR SECOND CUT

Don't forget that a sharp band-saw is a good tool, and sawing to the line not quite a lost art.

Don't use your material for a foot-stool before working it up. It's hard on the machines.

Don't wait until the rip or band-saw is just sharpened, then saw nails; if it must be done, do it before.

Don't swear when your plane hits a nail. The chances are you put it there yourself.

Don't sandpaper each piece as you put it on the pattern, then plane it afterwards. It takes time to sharpen tools, and—

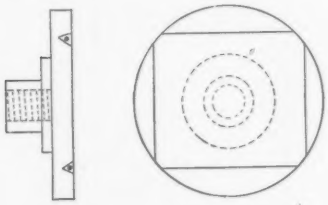

FIG. 10—HOME MADE SANDER

Don't forget to buy your own.

Don't round up the ribs and corners of a pattern until all pieces have been assembled.

Don't throw too much work on the foundry, but occasionally a little stopping off saves time.

Don't leave the making of the stop-off piece to the foundry carpenter; he may not see things as you do.

Don't glue cross grain, for a distorted pattern is very apt to be the result.

Don't glue two pieces of wood together that have just come out of the ice box. It's too chilly on the glue.

Don't carry your tools in a collar-box and expect the steady pins to furnish the ones you haven't got.

Don't borrow tools and forget to return them, and especially

Don't borrow when the other man is not looking.

Don't go to work so loaded that everything appears double. It's hard to guess the right thing. This applies only to a few.

Don't assume any pattern is correct; treat them all with suspicion until proven.

Don't proceed with the alteration of an old pattern, without first carefully checking it up.

Don't proceed with another workman's job without checking his measurements.

Don't use screws when nails will do the work as well; nails go quicker and are cheaper.

Don't forget that supplies and lumber cost money; if the other fellow is paying for them—so

Don't fail to practice economy, and

Don't lug in a 16-foot plank and cut a 4-inch or 5-inch print out of the middle; it's easier to turn over the scrap pile.

Don't keep your bench so littered up that it takes five or 10 minutes to find some small tool you just laid down.

Don't think because you happen to be a relative of some member of the firm that you are entitled to more privileges than any other man.

Don't try to do as little as you can for the most you can get, and—

Don't do any fooling during working hours; you are paid for working—not playing.

Don't fail to report promptly when your job is completed.

Don't stand around and look wise when waiting for a job. Get busy with your oil-stone. There are always tools to be sharpened.

Don't fail to check up your pattern when complete.

Don't leave your mistakes for others to find; find them yourself, and if you do—

Don't let them go on a chance of its getting past the checker. Be sure your sins will find you out, even if it does rope in the other lad.

Don't say "that is near enough."

Don't fail to number and place location marks on all loose pieces of pattern and core boxes.

Don't forget to place a marker upon the core print, if the core can be reversed.

Don't fail to nail the lead letters and numbers on the pattern. One nail in each letter is not enough to insure them staying right side up.

Don't number the core boxes upon the face of box; sand in time will wear it off.

Don't size up your job and guess at the amount of lumber; keep account of the boards as you cut them up.

Don't forget that an easy way to figure lumber is to multiply the length in feet by the width and thickness in inches, and divide by 12. Example: 9 feet x 8 inches x 1½ inches ÷ 12 = 9 feet.

Don't forget to mark upon the side of core boxes which way lifting hooks for the cores are to be placed.

Don't forget to mark the length of standard cores upon the pattern, when used. This saves the molder's time, as well as the core maker's.

Don't waste time doing unnecessary work.

Don't spend time and money giving patterns a piano finish. They are not used for ornaments.

Don't get into a rut of doing any certain work; try and improve upon your method, as well as lessen the time.

Don't think you know more than the boss, even if you do.

Don't expect the highest wages, unless you can produce the goods.

Don't make a practice of being late at work.

Don't do government work in the company's time.

Don't keep one eye on the boss and another on your job; it's difficult to watch them both.

Don't take off your apron and look for a chance to wash up before quitting time.

Don't dig ditches in the grindstone.

Don't touch a broken band-saw until the machine has stopped running.

Don't leave the jointer with a heavy cut on; run the table up.

Don't make the final calipering of your work while the lathe is running.

Don't use double-ended turning tools, they are dangerous.

Don't forget that a tooth plane bit makes an excellent turning chisel for straight work.

Don't forget that dowel pins belong in the cope half of pattern.

Don't fail to secure your work well in the lathe either between centers or in the face plate.

Don't stand directly in front of the rip saw, when sawing; they sometimes kick.

Don't provide bottom boards for core boxes unless necessary; they are often a waste of time and material.

Don't forget to make your core boxes scant in length and width, as cores, when drying, usually sag and swell.

Don't fail to make the necessary provisions for rapping and drawing the pattern.

Don't forget to allow ample material for finishing the casting.

Don't forget to consider how the casting is to be machined, and provide the necessary tool clearance.

Don't forget to put in tie pieces when required, to keep castings from spreading or cracking.

Don't fail to consult the molder; his suggestions may be helpful, and we cannot do without him.

Don't forget that the molder will always try to blame the patternmaker for his own mistakes, if he possibly can, and—

Don't forget that the molder is in a position to show you your shortsightedness, so—

Don't fail to consider the convenience of the molder and coremaker at all times.

Don't think that your own time spent in the foundry is wasted; it may or may not be, it lies with yourself.

Don't be too important to do insignificant work.

Don't fail to have confidence in yourself, but—

Don't think you are a patternmaker because you have been inside a pattern shop.

Don't lose your head when anything goes wrong; other people have made mistakes.

MANGANESE IN CAST IRON

By Herbert E. Field, Pittsburg, Pa.

The literature in regard to the effect of manganese in cast iron contains many contradictory statements. As is usual in such cases, these statements were correct for the work with which the writers were familiar. The errors come from drawing general conclusions from special experiments. Four years ago, in a paper before your association, I called attention to the confusing statements in regard to carbon in iron. I then cited two opposite statements made by different authorities and showed that both were correct in the limited area of their experiments. Today I wish to reconcile the diverse opinions in regard to manganese in cast iron.

Effects of Manganese on Hardness.

One authority states that manganese hardens iron, while another as confidently asserts that it has a softening influence. Both are correct. There are two conditions which determine the effects of manganese on iron; first, the percentage of sulphur present and second, the amount of manganese. These two conditions are so bound up with one another that it is almost impossible to consider them separately.

Manganese tends to increase the per cent of total carbon; to increase the amount of carbon held in the combined condition; to decrease the sulphur; and to neutralize the effect of the sulphur.

Action of Manganese in Increasing Carbon.

Manganese itself will hold more carbon in combination or solution than will iron, hence, an increase in the per cent of manganese in an iron tends to increase the carbon. This is especially true in cases where the manganese is added to the ladle as ferromanganese or spiegel, since the per cent of carbon in these two increases the per cent of carbon in the whole.

When the manganese is charged into the cupola, it acts in two ways to increase the carbon. First, it partially prevents the carbon from being oxidized when the iron passes through the melting zone of the cupola, and second it increases the absorption power of the iron for carbon and hence, the iron in passing through the incandescent coke, will absorb more carbon. The higher the manganese present, the greater will be the amount of carbon so absorbed. In the paper above referred to, I pointed out that, other things being equal, the higher the total carbon, the softer will be the cast iron. An increase in the manganese then, tends to soften the iron by increasing the total carbon.

Action of Manganese in Increasing Combined Carbon.

The softening tendency, due to the manganese raising the total carbon, is to a certain extent, counter-balanced by the action of manganese in forming combined carbon. This combined carbon is not the hardening carbon which gives the intense hardness to quenched steel but is a definite compound of manganese and carbon. The carbon so united is called carbide-carbon. It is this tendency to form a hardening carbide that has led many to state that manganese hardens cast iron. The hard, gritty nature of some high manganese irons is due to this carbide. We are all familiar with the high manganese pig irons which have a dark, open No. 1 fracture, which, even to the expert eye, would be graded as a number 1. When we try to drill this iron, we find that it is almost impracticable to do so with any ordinary drill and with specially hardened and shaped drills, it grinds rather than cuts. This peculiar nature of high manganese

iron which makes it so hard to drill is due to an innumerable number of small particles of this very hard carbide.

Action of Manganese in Decreasing Sulphur.

It has long been known that manganese tends to eliminate sulphur from iron in passing through the cupola. This elimination is due to the fact that manganese forms a compound of sulphur which separates out of iron at a high temperature. This temperature is above the melting point of iron and hence the compound passes off into the slag. Sulphur hardens iron and, as manganese tends to eliminate sulphur, it has a decided softening influence upon the iron. This influence, of course, is an indirect one, as it is due to the absence of the sulphur rather than to the presence of the manganese.

There has been considerable discussion in the last few years over the value of manganese ore as an eliminator of sulphur in cupola work. Some German experimenters have stated that a large proportion of sulphur may be removed by the correct use of manganese ore and limestone. Some of our American foundrymen working on the same lines, have obtained results which are not nearly so convincing. Many reasons have been given for this discrepancy in results and the prevailing opinion seems to be that the difference is one of temperature. The use of manganese ore in cupola practice is open to several objections and as high manganese iron can be readily obtained which will introduce the manganese in a very satisfactory manner, the former method is hardly to be recommended for ordinary cupola practice.

Notes on Previous Work.

A few notes on previous work on this subject might be of interest. A. E. Outerbridge, in a lecture before the Franklin Institute, in 1888, called attention to the remarkable effect of the addition of a small amount of manganese to a ladle of cast iron. Prof. Turner, the English metallurgist, states that manganese eliminates the sulphur as in manganese sulphide which floats on the surface of the molten iron, thus forming a part of the slag which collects at the top of the metal.

Walrand melted cast iron high in sulphur in one crucible and manganese in another crucible and when the two were poured together, a strong odor of burning sulphur was given off. The sulphur was reduced from 0.5 to 0.06 per cent.

Caron's experiments along the same line gave the same result and he is said to be the first to call attention to this peculiar feature of manganese, in its action on sulphur.

J. W. Stead melted 100 parts of ferro-manganese with sulphide of iron in a crucible. The metal produced showed 0.02 per cent sulphur while the slag analyzed 28 per cent sulphur and 56 per cent manganese.

The Action of Manganese in Neutralizing the Effect of Sulphur.

We have noted that the effects of manganese in eliminating sulphur was due to the formation of a sulphide of manganese which floated to the top of the iron and formed a part of the slag.

Prof. Le Chatelier and Mr. Ziegler first suggested that this effect was produced by the segregation of sulphide of iron at a temperature above the melting point of iron.

Effects of Sulphur.

The effects of sulphur on iron are too well known to be discussed here. It makes iron short, brittle, and hard. Excessive amounts make it very weak. These effects of sulphur are due to the fact that when cast iron solidifies, the sulphur is still in a gaseous state and each particle of iron is surrounded by a wall of gaseous sulphur. When the iron cools, the gas solidifies or unites with the surrounding crystals of iron as iron-sulphide. In this latter condition, it occupies much less volume

than when it was in the gaseous state. This leaves the crystals of iron surrounded by small spaces which, under the microscope, have the appearance of very minute cracks. These cracks give to the iron the brittle, short property characteristic of high sulphur iron.

The point to be borne in mind in this connection is that the sulphur is in the form of a gas when the iron sets.

Let us go back for a moment and consider the effect when manganese was added to irons high in sulphur. The manganese united with the sulphur and the sulphide of manganese separated out at a temperature above the melting point of iron or, in other words, while the iron was in a liquid condition so that when the iron solidifies, there will be no sulphur left as a gas to form microscopic cracks, it having already united with the manganese to form sulphide of manganese. The bad properties due to high sulphur would, therefore, be removed. In place of the gaseous sulphur, we have present a sulphide of manganese which will rise to the top of the iron as a slag, provided sufficient time is given for it to do so. If, however, there is not sufficient time, the sulphide of manganese is held in the iron in suspension, in the form of infinitely small, solid particles. These are invisible to the naked eye and do no more harm than so many particles of any solid substance.

There are times, however, when the casting remains liquid for a long time that this sulphide of manganese will segregate together towards the top of the casting and form bad spots which are difficult to obviate and which are frequently blamed to very different causes.

In spite of the fact that the effects of sulphur on steel and the effects of manganese on sulphur have been known for a considerable time, it has only been within a comparatively short time that this knowledge has been applied in a practical way, or that the facts have been brought together and a lucid explanation given of the cause and effect of the additions of manganese to steels high in sulphur. The credit of bringing this subject again to the attention of metallurgists is due to J. O. Arnold.

While working on a sample of steel rail high in sulphur, furnished by Mr. Brinell and recorded as giving good results, he discovered that instead of the fine, microscopic cracks which would be expected from so high sulphur percentage, that the steel showed in place threads of what appeared to be slag running length-wise with the rail. This was manganese sulphide and proved to be no more harmful to the rail than the fine threads of slag contained in wrought iron are to that product.

If we apply this to cast iron, we find the same conditions exist. The effect of manganese on cast iron, which has not previously been explained, under the light of this knowledge becomes clear. The statement that manganese softens iron is readily believed when we appreciate that it forms a compound with the sulphur thus removing its hardening effect. The strengthening effect of manganese is easily explained when we consider that it removes the small, microscopic cracks caused by the sulphur.

It is very readily proved that manganese does unite with sulphur to form the sulphide of manganese in cast iron. It is not possible to separate it from iron by analysis but its tendency to rise to the top of the casting gives us a desired opportunity to prove our question.

Chas. H. Risdale gives the analysis of an ingot mold which showed in the top part 1.35 per cent manganese and 0.75 per cent sulphur, while the bottom part of the same mold showed 0.11 per cent sulphur and but 0.54 per cent manganese. An analysis recently sent me of a cylinder but 24 inches long and 9 inches in diameter gave the following analysis for sulphur

XUM

and manganese at the top and bottom of the cylinder:

2 inches from the bottom	Sulphur	0.148 per cent	Manganese	0.54	per cent
½ inch from the top	Sulphur	0.204 per cent	Manganese	0.66	per cent

It will be noted that this cylinder was but 24 inches long and that the time taken for it to solidify would be comparatively short and hence the time allowed for the sulphide of manganese to rise would be of a very short duration.

The top of a water pipe cast on end gave sulphur 3.06 per cent, manganese, 1.136 per cent, while the bottom end showed but 0.076 per cent sulphur and 0.584 per cent manganese. The top of another pipe gave 0.43 per cent sulphur and 1.79 per cent manganese, but, unfortunately, no piece from the lower part was saved. These show a simultaneous segregation of manganese and sulphur from molten iron. Inasmuch as manganese would not be expected to segregate by itself, it would appear that this compound must separate out and rise to the top of molten cast iron.

The writer considers that this explanation of the effects of manganese on cast iron reconciles the conflicting statements in regard to the same. It explains the segregation of sulphur and pig iron which has long been known but never explained. It shows why sulphur makes iron weak and that when united with manganese, it has practically no weakening effect on iron. It explains the remarkable effect of small amounts of manganese when added to a ladle of cast iron. It shows why high manganese may cause dirty iron.

THE TRAINING IN FOUNDRY WORK AT PRATT INSTITUTE

By Prof. Wm. C. Stimpson, Brooklyn, N. Y.

At the present time, when there is so much being said in the daily papers and the current magazines about trade and elementary technical education, this Association may be interested in a short description of the instruction in foundry work given at Pratt Institute.

Before attempting to describe what we are doing I should like to point out a few things that we do not attempt, in order that there may be no possibility of misapprehension regarding what I shall say later. To start with, we are not a true trade school, and we do not attempt to turn out journeymen mechanics. We cannot graduate journeymen molders because the time devoted to foundry work is far too short, and the class of young men who mean to earn their living as practical mechanics in this trade could not make the sacrifice of either time or money that would be required to thoroughly master the trade in a school.

On the other hand, we are far removed from the engineering schools of college grade like Cornell or Columbia or the Massachusetts Institute of Technology. In some instances we may teach the same or similar subjects, but we approach them in a very different way, and the attitude of our students toward their work is also quite different.

I have pointed out these two things that we are not a trade school on one hand, and an engineering school on the other, because I believe it will help us to a clearer comprehension of the field we do cover, which lies almost exactly half way between these two.

Courses of Instruction.

We aim to give at Pratt Institute courses of instruction which will properly prepare men to rise to positions of the grade of master mechanic, or foreman, or assistant superintendent, after they have had sufficient practical experience. For positions of this kind some theoretical training is necessary, but to make it effective it must be combined with a great deal of very practical training.

So far as our work turns in either direction, therefore, our methods, I believe, tend to approach more nearly those of the trade school than they do those of the engineering school; for, in the main, our men learn how to do things by actually doing them, and incidentally study the whys and the wherefores of the work as they go along; for we do not want them to do anything which they cannot do intelligently. It should be noted, however, that the emphasis is placed very largely on the quality of the actual, practical work.

Thus far we have not specialized at all along the different manufacturing trades such as pattern making, foundry work, machine forging or machine work. Our aim has been rather to turn out men who would be likely to go into manufacturing plants which include several, or perhaps all, of these branches. At the present time, therefore, we have no course designed especially for foundrymen in which the student can devote his entire time to this kind of work, but if it were plain that there were sufficient demand for such a course I am not at all sure that our trustees might not feel inclined to consider its establishment.

In most manufacturing establishments, however, the four main constructive departments referred to above are so closely related to one another as to require men who have some intelligent understanding of all these branches, and the purpose of our reg-

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ular mechanical course has been to provide instruction for such men.

Departments.

In describing the aims of this course, into which the foundry work enters as a most important element, or in giving the more detailed description of the foundry which will follow, I do not wish to give the impression that this is by any means the only course offered by Pratt Institute, for, as a matter of fact, there are now more than sixty other courses, many of them day courses and others evening courses, in all of which, taken together, there is an enrolment of between 3,600 and 3,700 students drawn from nearly every state in the Union and from a number of foreign countries. It requires nine different buildings to house

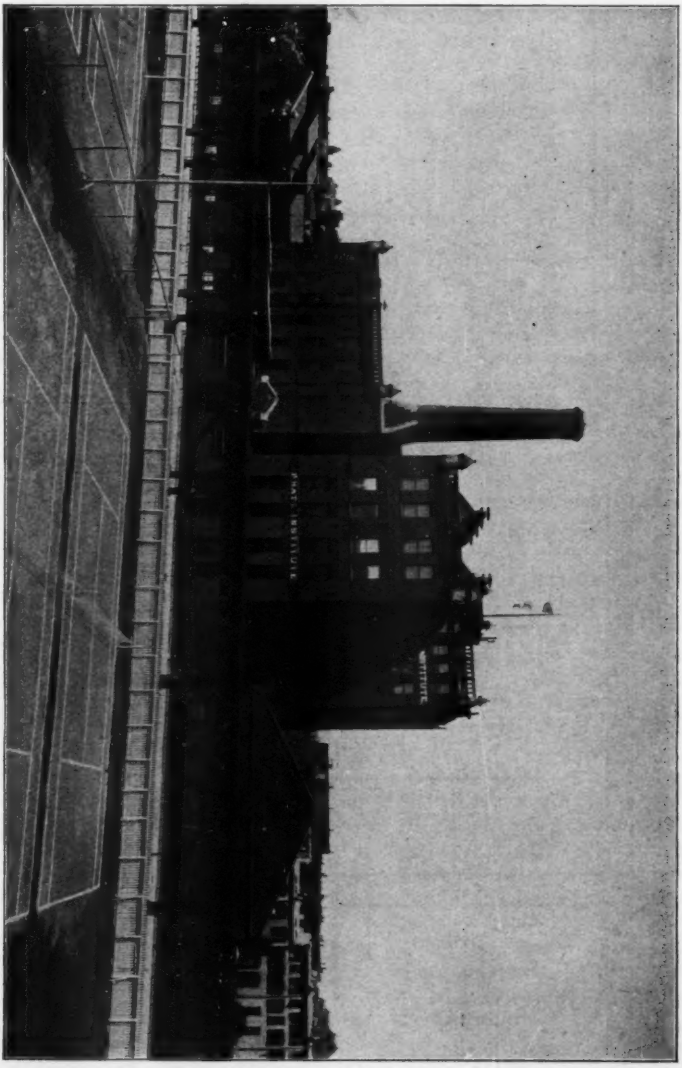

FIG. 1—SCIENCE AND TECHNOLOGY BUILDING

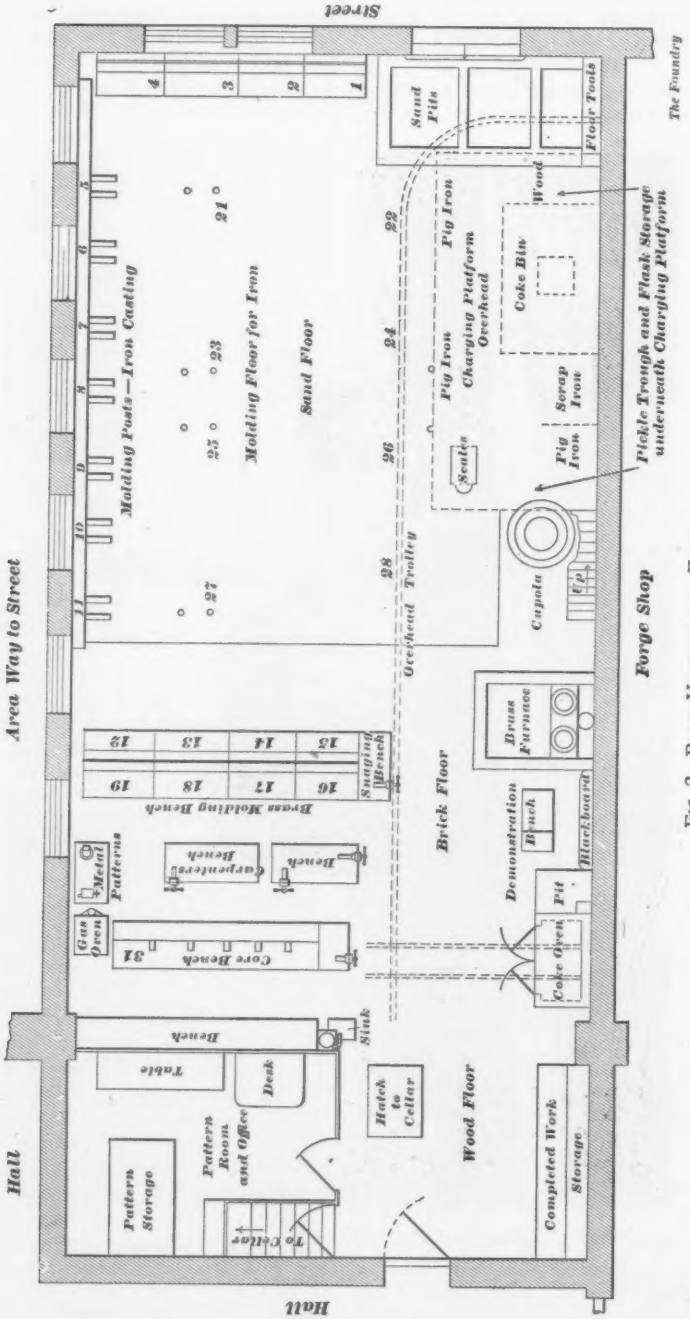

FIG. 2—PLAN VIEW OF THE FOUNDRY

these classes, but those in which we are principally interested are the chemistry building, the electrical building, and the so-called science and technology building, Fig. 1, which contains the department of physics and practical mechanics, mechanical drawing and machine design, and most of the shops. Grouped together in these three buildings is what is known as the Department of Science and Technology, and before discussing the details of the subject of this paper it may not be amiss to give a word or two of description of the department as a whole, and a list of the technical and trade courses which it offers, in order to give the members of the Association some idea of the setting which surrounds the foundry work at Pratt Institute.

The Department of Science and Technology.

Some idea of the importance of this type of education can be gathered from the fact that the Institute which Mr. Pratt founded only twenty years ago started with an enrolment of but twelve students and has grown to the proportions mentioned above; and during these twenty years has given instruction to more than sixty thousand individuals. Mr. Pratt, when he started the school, was guided and inspired very largely by his own experience. He was a self-made man, having started life as a machinist, but he was a man of unusual breadth and power. He wanted a school where young men, and young women, too, for that matter, who were situated as he had been could have the chance that he had missed. He knew what they needed; and he knew where the average school failed. He thus was able to plan with an insight and a foresight which has everywhere commanded admiration. In all this he never lost sight of the value of machinery, especially in practical work; but, nevertheless, he always put his emphasis on the value of the workman back of every piece of machinery. He always saw the man who designed it, or the mechanic who made it, or the operator who tended it, and he wanted Pratt Institute to reach out and help these workers, and to reveal to them both the possibilities of their work and the possibilities for their own development through even the most commonplace tasks.

With this outline of the aims and purposes of our course in steam and machine design as we call our two-year mechanical course; and also of the more general scope and purpose of the work at Pratt Institute, I will now proceed to a detailed description of our shops and of our instruction in foundry work.

I have already said that the time devoted to foundry work was limited. The whole course is two years in length and the students' time is divided among a number of subjects. A typical day for each student would be as follows: One-half of the morning in class room for mathematics and perhaps practical mechanics; and the other half on the drawing board, mechanical drawing, or machine design. The afternoon would be alternately spent in either one of the four shops, or some kind of practical laboratory work, the share of the time devoted to foundry work being about two afternoons per week for six months in the year, a total equivalent to about twenty working days of nine hours per day. All that we accomplish, therefore, we have to do in this limited length of time.

To illustrate the general character of our shop equipment and the emphasis which we place on the practical side of the instruction it may be noted that our machine shop occupies two entire floors, having a combined floor area of nine thousand square feet. It is equipped with ninety-four machine tools of various types, the greater part of them being the most modern design, and in this floor space we can handle one hundred and twenty men at a time. The pattern shop, too, is a fine, large, splendidly lighted room about ninety-five feet by forty-two, with a model mill equipment and independent motor drives. In this shop we can handle a class of sixty men.

Both the forge shop and the foundry are in their original quarters, but we are looking forward to the possibility —which I trust may not be in the very distant future—of having a new building for both of these departments. In the forge shop we have anvils for thirty-five men at a time. The foundry, too, is housed in the same room as it was when the school started, but with the growth of our classes we have enlarged the molding floor to about three

FIG. 3—INTERIOR VIEW OF THE FOUNDRY

times its original area, and have decreased to a minimum the space occupied by supplementary benches. In this way we are able to handle the present large classes satisfactorily; although at the present time more space is sorely needed for the extension of the work in several directions.

The Foundry Course.

Now turning to the instruction given in the foundry course itself, I believe you would be interested in these three phases:

First—The aims of the instruction.

Second—The routine work of the school shop.

Third—The practical methods of presenting the subject.

The aims of the course briefly, are first to give our men an understanding of the underlying principles which operate in the production of sound, smooth, workable castings, to make them able to recognize the defects in a casting, tell the cause and suggest a proper remedy, to have some judgment in deciding the best way to make a pattern and to mold it, taking into consideration the number of castings required and the shop conditions, to understand some of the best methods of duplicating work in various quantities, both in the jobbing shop and in the manufacturing plant, to have some experience in the melting of iron and brass, and be familiar with the basic principles regarding the mixtures; to be able to make good, commercial

molds and cores for any simple, light casting; to vent, gate and pour these molds so as to produce sound, clean, marketable castings of high grade, and to do this in a business-like way.

Coming to the second phase of the subject—the routine of the school shop

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—a few words regarding the equipment of the foundry will be of interest.

Arrangement of Foundry.

The accompanying plan, Fig. 2, shows clearly the general arrangement of the shop, which occupies a room 28 x 56 feet in a one-story ell with a small room in the basement for cleaning the castings. It is nineteen feet in the clear on the inside and is well lighted on the east and north by large windows, and has two turret ventilators with swinging windows on their four sides. Arc lights supply the light on winter afternoons.

The cupola, the base of which may be seen in Fig. II, is at one side and is charged from a platform 10 x 20 feet, suspended from the roof. On this platform we keep our coke and our supply of about six tons of pig iron which we convey there from the floor by an old though very rapid, type of conveyor, a line of men passing the pigs from one man to the next. You will see cost of labor is not the most important item with us, and this kind of occupation helps a lot toward getting the boys into the right attitude of mind toward their work. The coke is hoisted to the roof and dumped through a trap into a bin on the same platform, which has a capacity of three tons. On the dark side of the room in the space underneath this platform, convenient to the cupola and molding floor, is a large box for the molding clay and facings. Here, also, we keep the pickle vat and buggy, the racks for holding the ladle shanks, skimmers and similar appliances. In the corner nearest the street door are the pits into

FIG. 4—CASTINGS ON PICKLE BUGGY

which we dump our annual supply of molding sand and similar materials, and always have them ready for use with the least possible handling. A case for keeping the small tools used on the foundry floor is built against the wall near these pits, as shown in illustration Fig. 12. This leaves the three best sides of the shop free for the bench molding, giving us stations for fifteen men; and marked off on the foundry floor by wooden pegs are eight floor stations at which we work sixteen more men. This molding floor is laid on a bed of puddled clay with a considerable thickness of well packed molding sand on top.

The core, brass and repair benches are placed as far into the west corner of the shop as possible so as to give as much space as can be had to the iron molding. These features, however, will be spoken of in detail later.

In starting all the foundry classes we give first a graded series of six or eight preliminary lessons in making practice molds which are not to be poured in iron. Often a couple of the best of them are poured in white metal to more clearly illustrate the relation of the parts of the mold. In this work the instructor himself makes a mold for each type of pattern, doing so before the class, and all the students work on the same general class of patterns at one time. This preparatory course of instruction covers the important and most fundamental operations of foundry practice, such as packing a flask, making a joint, tucking under cross bars, setting the gaggers, making pouring basins and gates, and making and setting the simpler forms of cores.

FIG. 5—WASHING AND SORTING CASTINGS

At this point the class usually visits some good jobbing foundry and is expected to notice especially the forms of pouring basins, the clamping of molds and the methods of pouring. Such visits are repeated from time to time during the course, to representative foundries in Brooklyn and vicinity. From this time on the heats are regularly run in iron each week, and the molding for the individual students is differentiated, the conditions being made to approach as nearly as possible to the practices in the best commercial foundries. The men are given such

work as in the judgment of the instructor will keep them alive with interest and at the same time tax their power and ability enough to make them think.

Since this endeavor to approach commercial conditions holds throughout all shops and laboratories, we have, as a rule, a sufficient amount of work that is needed in the department to keep the foundry busy without resorting to the making of practice castings which have no useful purpose. And the variety in our work is always great enough so that we can give to each man some job that will inspire him to do his best.

Our first heats are usually run with a very soft mixture, into small brick-shaped blocks. These are used the following year in the machine shop for the first exercise in chipping. We make about 300 each year.

Subsequent heats are mixed to give a good strong iron suitable for general machine castings.

It will be recalled that our students practically spend every other half day in one of the shops, and two half days a week for a period of six months is the usual time devoted to foundry work.

We handle on an average about 120 men per week divided into sections of about 30 to 35 men. Of course these sections cannot all take the same thing at the same time, so some of them report to the foundry in the mornings and some in the afternoon.

Perhaps the most concise way of showing how our shop is operated will be to describe its workings for a period of one week.

Shop Operation.

For purposes of illustration we will consider that the week begins on Wednesday, as on that day we begin to put up molds for the heat.

At 9 o'clock a section reports in the shop. The men are called before the instructors' bench, and after discussing the castings they made in the last heat, a short talk or demonstration is given them in accordance with a definitely planned course of instruction. Then their assignments for the morning's work are given out and they go to the bench, floor or core bench as directed, and do their best to get out their work within the time limit, as their mark depends largely upon the castings they make.

When his mold is finished, the boy sets a small cast iron cover plate over runners and risers to protect them from accidental loose sand until pouring time. Under the edge of this he places a yellow slip giving job number of the work and weight of metal required. When cores must be set the following day the fact is stated very clearly on the same slip.

Before leaving, one man—assigned weekly—takes acccount of the weight of metal required by each member of the class and enters it in the proper column on the Cupola Record, which will be described later.

In the afternoon another section begins its work. This class is given more of a lecture, dealing with the general methods of manufacturing pig iron, the effect of the different metaloids on the grain and strength of cast iron; how malleable iron and steel castings differ from cast iron, etc., and topics of like character which will show the important place the chemist now holds in modern engineering.

Their time is very short and they put up only the simpler work. About every second week they run a heat in one of the alloy metals—brass, bronze, or aluminum—and when this is done, one man is given the job of caring for the furnace. He weighs out the mixture and charges it; pulls the pot and handles the ladle.

All molds put up by this class have the weight of metal noted on a white slip, so that they can be quickly distinguished from those of the other classes.

On Wednesday the janitor (who had been trained to care for the cupola), chips out, daubs and puts up the bottom of his furnace, repairs the lining of his ladles, and gets the large core

oven ready to light the first thing in the morning.

This work is done by our man because the class of students in the shop on this day is not such as would in our judgment benefit enough by the experience for us to risk their attempts at preparing the furnace.

Daily Routine.

On Thursday morning, there is opportunity for the instructor to plan out the assignments for the afternoon and see that flasks suitable for the jobs are at hand. He decides on the metal mixture for the heat and figures the bed charge.

The metal put up by the two classes already mentioned usually makes about one-third to one-half the total charge.

Fire is put in the large oven, and in it are baked the ladles and any large cores needed; and the fire is laid in the cupola. These preparations also are made by the janitor (melter) as the regular classes are occupied with other work at this time.

On Thursday afternoon a section which has been in the shop a longer time than the others reports, and to it is given the most important work as well as the job of pouring the heat. The class is divided into four groups or squads according to their positions at bench or floor, and one member of each squad is appointed by the instructor to act as foreman. The work is assigned through the foreman, and he is responsible for the molds of his gang, in the following particulars:

First. Gives out patterns (under suggestion from the instructor).

Second. Gets weight of metal from his men and reports the total to the melter.

Third. Puts up his own work.

Fourth. Assigns men to pour and skim his floor and to start various work when it comes to cleaning shop.

Fifth. Makes himself familiar with weight and type of work in each mold on his floor and keeps watch that they are not poured short.

Sixth. Makes a report to instructor, on a blank furnished, regarding assignments, number of molds up, time of men, and number of molds poured.

These reports furnish the data for cost sheets which are kept for each job going through the shop.

One man also is assigned to help the melter through the afternoon. From the reports of the four foremen he gets the total metal required for the heat and figures the remaining charges, then helps the melter weigh these out and charge the furnace. He tends the fire that dries the cupola breast, places the ladle shanks handy to the core oven, and sees that skimmers are in readiness; in fact, does whatever the melter tells him to do to help make the heat run smoothly. This man records the actual weight of charges, and the times of charging, blast, first metal, etc., and after the heat sees that all the furnace appliances are returned to their proper places so far as possible.

It will be seen from the above that while five men out of the class have rather special work, the majority of the fellows are actually ramming up molds, Fig. 3, setting cores, clamping and weighing, and in this hour and a half the bench men will put up two to four molds each and the floor men only one or two, according to the class of patterns they have.

It is not practicable to have each man pour his own mold every heat, because the space is so small. Usually four men with hand ladles pour the lines of bench work and four other men pour the floor molds, using a small bull ladle.

Assigning Patterns.

In assigning patterns in the first place the order of pouring is taken into account, to get the less important pieces where they will receive the first tap of metal, or be furthest from the cupola, and the very light work or machinery casting which requires especially hot metal in a position near the stack.

During the heat the four foremen stay right on their floor and direct the order of pouring the molds; they

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PRATT INSTITUTE FOUNDRY.

HEAT RECORD.

Heat No..... Poured by..... Date.....

CUPOLA DATA.

Charge.								Heat.			Results
								Fire lighted ..			Good
					Scrap	Total	Coke	Iron charged.			Poor
1								Blast on.....			Scrap
2								First metal...			Lost
3								Bottom.....			Hardness
								Gauge.....			Max. fib. str.
								Melt per min..			Si., est. % Ac'l %

Remarks: .....

.....

SPECIAL ASSIGNMENTS.

During Heat.		Straightening Shop.	
Cupola tender		Ladles.....	
Foreman—Benches		Riddlers.	
" —Floor		Corner case ..	
On ladles	Skim	Flasks.....	
Big Bull		Patterns	
Small Bull			
Hand 1		Weighed by...	
Hand 2		Cleaned.....	
Hand 3		Ground.....	
Hand 4		Graded.....	

WEIGHT OF METAL UP.

Bench Molds.						Totals.				Floor Molds.			
	S.&M.D.	A. E.		S.&M.D.	A. E.			S.&M.D.	A. E.		S.&M.D.	A. E.	
1			9			Cupola	21			22			
2			10										
3			11			Floor	23			24			
4			12										
5			13			Figure on	25			26			
6			14										
7			15				27			28			
8			16										

FIG. 6—HEAT RECORD

very often skim the ladles themselves, while other men shift weight for the bench molds.

The bench molds are run first and by the time the floor work is poured the bench men have begun stripping cases, and dumping the molds. Then, when the bottom is dumped, they begin to rake out their castings and bring them over to the floor near the cupola, and start sifting a pile of sand, as all the sand for bench work is

day, with the exception of calling the roll.

The next morning, Friday, the instructor and the janitor weigh up the result of the heat, and get the castings on the pickle buggy, Fig. 4. This gives the instructor a chance to examine every casting as it comes from the sand to become familiar with the work each man is doing, and so be able to advise him how to better his work. The janitor then clears away

FIG. 7—SETTING A LARGE CORE

put through a No. 4 sieve after each heat to remove the shot, etc.

The floor flasks are now stripped and as soon as possible the castings are removed and the piles cut through once. A little new sand is added to all the piles after each heat to keep the sand strong.

The work of straightening up all of the benches, corner case of tools, etc., is divided among the men of the different gangs; this includes breaking the gates from the castings and separating the poor from the good castings. This ends the work of the heat

the dump and cuts through the sand again ready for the afternoon class.

The Friday afternoon class receives its instructions by means of lectures and demonstrations, and by putting up molds simply for practice. The men gain their experience in casting by running heats in brass or aluminum, and twice in the term they run an iron heat, the Thursday afternoon class putting up most of the molds for it.

There is no regular class work on Saturday. The morning is usually spent in checking up accounts and

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planning what work shall be taken up the following Monday.

On Monday morning the section that poured the heat again comes in. These men are called up and the heat of the previous week discussed and the special work to be cast in the coming heat talked over. Following this a short talk is given on some specific phase of foundry practice, as for instance core sand mixtures, routine of cupola work, foundry ladles, suggestions regarding foundry equipment and arrangement. This occupies about one-half hour. Then the men are given

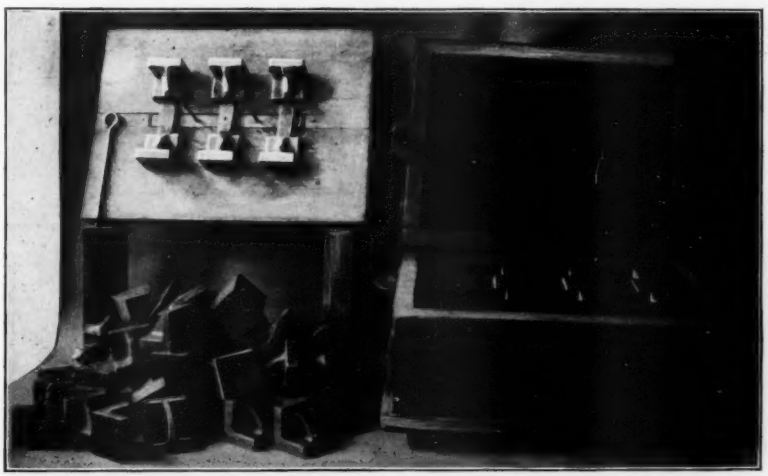

FIG. 8—SMALL ANGLE BLOCKS

various assignments, as repairing flasks, fitting flasks to new patterns, making cores, or running a brass heat. Some put up typical molds which illustrate methods of molding but which are not to be cast; for instance, the various ways of molding a groove pulley, ramming a flat core over a picked out detail to save making a 3-part mold; or the use of a green sand core rammed in a wooden lifting box to get over using a shallow cheek.

Two to four men are detailed to wash and sort the castings, Fig. 5, which were put on pickle on Friday. Every man taking foundry has a small 3-figure number-stamp with which he can mark every casting. The first figure or hundreds, indicates his class, the other two indicate his section and individual number. So, after washing, the castings of the various classes are put in separate piles, then these piles are arranged so the student numbers run in consecutive order. Before grinding the instructor credits each student with the number of castings he has turned out and gives him a mark for the same. These marking sheets then show at a glance just what each man in the class is turning out.

Two other men are assigned each Monday to finish any grinding that may have been left undone by other classes, and to get the finished castings properly stored. And as repair or construction orders are filled, to weigh up and deliver such castings to the department ordering them.

Thus you will see that the whole routine of the foundry work is carried out in the four days, Wednesday, Thursday, Friday, and Monday.

Shop System.

We have in operation in the science and technology department a system of shop records, the design and use of which has developed from the urgent need of some such system. First to

prevent jobs getting side-tracked and forgotten; second, to aid the instructor in keeping track of the various projects being carried out by his classes; third, to get the men familiar with some form of cost keeping.

The description of the system would make matter for a paper by itself. Suffice it to say that it provides for a distinctive number for every constructive job passing through the drawing room and shops. These numbers show the department to which the job belongs, the class of work in that department, and the consecutive number in that class; with provision made by use of the decimal point, for the detailing of every part of the job.

history of the job, and when the work is finished the results are summed up and duly entered, first on the construction ticket and its duplicate in the drawing office. And when all shop tickets have been entered up, showing that the job is finished in all of the shops, the data from them are entered on the cost card, giving in condensed form the total cost of the job.

All patterns therefore are numbered according to the job to which they belong, and this number is used in all records of their handling through the foundry. By this system the foundry knows at the end of the year exactly the weight and cost of castings it has delivered to the other departments.

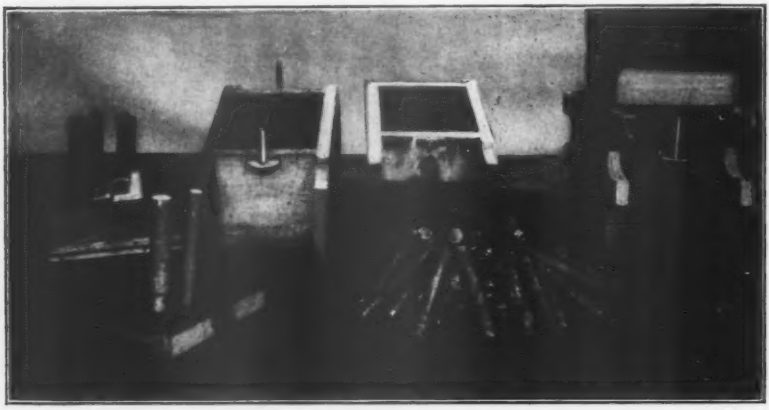

FIG. 9—SMALL CYLINDER CASTINGS

For every distinct job a cost card is filed in the drawing room office, and construction tickets issued to every shop having work to do on the job. These constitute the formal order for the work. Then, to keep track of details, each instructor as he receives the construction ticket, prepares a construction sheet, 8 x 10 inches, conveniently ruled, headed with job name and number. Upon this sheet the entries of stock and student time is made; either from foreman's reports or from time slips made out and passed in by the students who do the work.

This sheet now gives the complete

Foundry Records.

Another set of records which apply to the foundry work alone is systematically kept. These are the heat records, Fig. 6, and they are arranged on a standard size sheet, as shown, and provide for entering the data, the consecutive number of the heat and the class pouring same, the number and weight of the charges of iron and coke, time of lighting fire, charging, blast, first metal and bottom, as well as blast pressure. The weight of good castings, poor castings, scrap and lost metal are also recorded with space for per cent of silicon in resultant castings, the maximum fibre stress

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of test bars, and record of comparative hardness of metal. This latter has not been a necessity in the majority of heats, as our castings are usually of standard mixture, which has been already tested and had given satisfaction in our machine shop. The middle section of the heat record sheet is used for making special assignments during the heat, and at the bottom is provision for noting the weight of metal needed at every position by three different sections.

The results in reference to weight of good and poor castings, etc., have been summed up each year since 1902-03 for comparison. The following table speaks for itself:

In looking at these figures it must be remembered that the men who turned out these castings were practically green men.

With the present year the classes of the industrial chemistry course are making analyses for us of the stock we use and the results obtained and these are brought to the attention of our foundry classes in connection with the results of the physical tests on the same castings.

FIG. 10—SWEEPING A GREEN SAND MOLD

Core Making.

In core making the larger part of the work deals with small cores. For this we have one flat top bench at which six boys can work, and a gas core oven built in our own shop two years ago. With this we easily supply all cores needed for the general run of our work. We have four standard mixtures,

RESULTS IN SCHOOL FOUNDRY, PRATT INSTITUTE.

Year—	1902-03	1903-04	1904-05	1905-06	1906-07
Number of heats	23	23	24	23	15 to April 1.
Total weight of iron charged	18,300	21,000	19,000	27,800	19,700
Ratio—lost metal to iron charged	17*	14*	11*	10*	8*
Total weight of good castings	7,800	10,800	8,800	15,400	11,300
Total weight of poor castings	1,800	1,500	1,600	1,500	1,000
Ratio—poor castings to good	23*	14*	19*	10*	8*

*Per cent.

using different core binders to make the men realize as far as possible the different properties of each.

We have also a brick oven, 3 x 5 x 6 feet for use on larger cores. The sand for these we mix in a large box and set the core box on a pair of horses while ramming up. As we are next door to the forge shop the boys can quickly make their rods and hangers for themselves. Our cinders are obtained from the institute boiler room down stairs.

Albany sand, held in four molding troughs which will accommodate six men with a little crowding. Iron flasks are used for this work.

There is a twin furnace capable of holding two No. 30 pots. But the limits of the molding benches make one pot sufficient for our heats; which usually do not run over 40 or 50 pounds.

Our work here is largely for bushings and small instrument castings and a large number of electrical fittings. The slide shows a gate of line terminals left in the flask to cool to

FIG. 11—MOLD READY FOR POURING

Advantage is taken wherever possible to ram up the larger cores with lifting rods and with cinders inside, so as to illustrate the methods used on larger work and the reasons for same.

The illustration, Fig. 7, shows a core of this character being lowered into a mold for a coal box to be used on a new double forge we have built as an experiment in the forge shop. The casting is 27 x 10 x 12 inside and weighs 135 pounds.

Brass Work.

For the brass work we use a No. 0

demonstrate the shrinkage of brass. For these we had an order of 50. One master pattern with double shrinkage was given us on one Friday, and that day we cast eight off of it in white metal, and sand-papered them over. On Monday we set these in a flask and cast a gate of white metal patterns with 10-penny wire nails cast in for steady pins. This gate was scraped and finished the same morning. On Wednesday we made up a sand match and cast four flasks—all of that size we had— and we got 30 good castings from the heat. Three more flasks were poured when

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the section came in on Friday, thus completing the order.

Now a week's time may seem long for a man in commercial work to wait for 50 small castings. But when the interrupted progress of the work and the inexperience of the men actually doing the molding is taken into account, it will be seen that we are a whole lot nearer the commercial practice than the average school shop. And if you will bear in mind that the actual time for getting out the gate of patterns and 50 castings was but 10 hours, it will emphasize this point.

sionally the work is given over to the machine shop.

Typical Jobs.

The third phase, the practical methods of presenting the subject of foundry work, has already been touched on several times in the course of this paper, but here are a few definite problems from this year's work which are typical of the jobs that come in to us right along.

Since our various departments often require a fair quantity of the same castings, we take advantage of this to demonstrate to our men the value of good

FIG. 12—DRAWING CAST IRON PATTERNS

We have spoken of metal patterns. A bench especially for this work was made last year. It has a cast iron top 30 inches x 60 inches, planed true to facilitate testing the work. On the bench is a soldering outfit, a Bunsen flame, 6 inch melting pot, and a 3 inch Welliamson vise. There are also drawers for storage of tools and work. The bench is near the brass molding troughs so that molds can be made up and conveniently poured.

Most of the gated work is made up in the foundry at this bench, but occa-

rigs for duplicating castings. Gated patterns for some brass fittings have already been mentioned. Here is a gate of small angle pieces, Fig. 8, from which we get eight molds a heat, whenever we run the very soft metal needed for the job, and we have four gates working, giving us about 130 castings a heat, allowing for losses. We make 250 of these each year, and increase the men working on them so as to get the lot out in but two heats.

A rig for the floor is shown in Fig. 9. The job is to make 350 perfectly parallel cylinders, 1⅛ inches x 8 inches

for use in the machine shop. They must be sound and free from blow holes for fine threads may be cut on them. As may be seen we have connected the runner with a skimming gate to insure clean metal and draw the separate cylinder patterns through a stripping plate to give a parallel mold.

Our first rig was designed and made about three years ago when we only required half the number of castings. The patterns were made of seamless brass tube and were fitted in iron bushings to be drawn with a ¼ inch draw screw, the other parts were of wood. Early this year we got up another rig. The patterns are of mahogany, and made long enough to project through the stripping board 2½ inches. This does away with the necessity of a draw screw. We used the other rig as a pattern, and made the gate and skimgate patterns of aluminum. The whole thing was constructed inside of a week by two or three men assigned from each of the foundry classes to push the job through. Special flasks and iron pouring boxes are used for this job, and extra long weights made which may be shifted very easily. The whole outfit suggests to the men manufacturing methods. With the two rigs we can turn out about 50 or 60 cylinder castings at each heat.

To demonstrate further the resources of foundry methods we swept up a couple of molds this year in green sand. We wished two round covers for the brass furnaces. We did not want either the delay or expense requisite on a finished pattern. We therefore cut two sweeps, and having swept up the sand pattern and lifted off the cope, we changed sweeps and worked up the drag mold, Fig. 10. The illustration, Fig. 11, shows the handle bar bolted to the cope, the pouring basin cut and the mold clamped ready for pouring.

We make two sizes of surface plates which are cast with the face down to insure sound metal. The larger one, 18 inch x 24 inch, weighs 180 pounds, and is made in a skin dried mold. The ribs are made loose on the pattern to facilitate pinning the green cores which hang from the cope. The smaller plate, 8 inch x 10 inch, is made by hanging a core in the cope to illustrate this method of supporting a core.

FIG. 13—GROUP OF SMALL CASTINGS

We are now building a molding machine in our shops, the castings for which are practically completed. It is of the hand rammed, stripping plate type, and we expect to rig up a few typical jobs on this to set the men thinking along these lines. In Fig. 12 may be seen three students drawing a cast-iron pattern for a gear wheel by means of a triplex block on the overhead trolley. The casting forms part of a hoist we built this year for the foundry. Fig. 13 shows a representa-

tive group of small castings turned out by our shop.

It will be noticed that we have practically none of the labor saving machinery which is found in many modern shops. The reason for this will be apparent upon a little thought. Our men are with us but a short time, and we want to help them to acquire as much skill in molding as possible and also some insight into practical foundry conditions. Now the productive labor saving devices, such as core machines, power molding machines, etc., are for the express purpose of employing less skilled labor, and for that reason do not fit our purposes. And as regards the sand shakers, they would undoubtedly save manual labor, but we are training men to go out into actual commercial works, and a most important thing for many of them to learn is to do with a will the thing he is told to do whether he particularly likes it or not. And in our judgment the moral benefit to those men buckling down and cutting through a floor of sand after a heat, and of snagging and grinding casting is greater than the physical strain or loss of time to them in doing the work this way.

While I said at the outset that our courses are not primarily aimed to train master foundrymen, we do believe that they are of very great value for any young men who are looking forward to such work.

We further believe that all of the instruction that is given in pattern making, forging and machine work, to say nothing of the mechanical draughting, mathematics, practical mechanics, and power plant operation, would be of inestimable value. In fact should we plan a foundry course, it is doubtful if we should wish to omit a single one of these subjects. Every one of them has, we believe, a most important bearing on modern foundry practice, and should be included in every wisely planned foundry course.

The intelligent modern foundryman certainly wants some knowledge of the laws of mechanics and properties of fluids, and he should understand something of power transmission and power generation, too, for that matter. He should know how to read and make a working drawing, and he will have a broader view of his work if he has had some experience in the making of patterns, knows how to make a weld or temper a tool, and has had an opportunity to machine the castings that he has produced under various conditions and with different mixtures.

I think you will agree with me, therefore, that all of these things are needed in the ideal foundry course, and that this work which we give in our present mechanical course supplements in a most useful and efficient way the practical instruction which we are giving in molding and foundry work.

We are well aware that there are other things that would be useful and which we very much wish the time permitted us to include with the instruction we now give as I have just described to you. But the limits of a two years' course will not allow us to cover everything.

As I have already indicated, we are doing something along the chemical side and we are trying to get the boys to understand the relation between the chemical and physical properties of the metals as much as possible. We are also doing something in scientifically testing the physical properties of our material. And we are paying a good deal of attention to methods of duplicate production, and other economic foundry problems. We only wish time permitted us now to carry these lines of investigation as far as we hope we may be able to in the future.

And in closing you may be interested to glance at a few figures which demonstrate the growing demand for the kind of training we stand for. In a period of ten years the growth of our classes has been nearly four-fold as will be seen from the following table:

Year.	Day Courses.	Evening Courses.	Total.
1896	68	263	332
1900	136	363	499
1904	241	578	819
1906	284	783	1,067
1907	331	841	1,172

REPORT OF COMMITTEE ON STANDARD METHODS FOR THE ANALYSIS OF IRON

At the annual convention of the Association in 1905, this committee reported a method for the determination of silicon in iron, and last year added methods for determining total carbon and sulphur. The committee now adds methods for determining graphitic carbon, manganese and phosphorus, thus including all the determinations usually made on iron in which occasion for difference between the buyer and seller is apt to arise. This report will therefore include all the methods decided upon.

We would also like to call attention to the following quotation from the report of 1905, which indicates the intentions of these methods.

"In recommending the above method, it was recognized that it is almost an impossibility to get chemists to use a standard method in their daily work. Hence the above method, as recommended, is intended primarily as a check method in case of dispute between laboratories, or as between buyer and seller.

"Hence a method, accurate in every point was sought, shortness being sacrificed to some extent to insure accuracy or the chance of error by a careless operator. Little in the above is left to the judgment of the chemist.

"It will be further recognized that in the purchase and sale of pig iron or castings under specification, that standard methods are essential in order to allow the parties of both parts to make their determinations with the assurance that, on the score of method, they are on the same footing."

We wish also to emphasize the ideas involved in the selection of members of this committee—that is to have representatives from commercial laboratories as well as works chemists, and to have members from different sections of the country. The success in carrying out these ideas will be seen by the following list of members:

Andrew A. Blair, Booth, Garrett & Blair, Philadelphia.
H. E. Diller, chemist, Western Electric Co., Chicago.
H. E. Field, metallurgical engineer. Mackintosh, Hemphill & Co., Pittsburg.
R. F. Flinterman, chief chemist, McCormick division, International Harvester Co., Chicago.
Allan P. Ford, metallurgist, Eaton, Cole & Burnham Co., Bridgeport, Conn.
J. O. Handy, chief chemist, Pittsburg Testing Laboratory, Pittsburg.
J. R. Harris, chief chemist, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
H. C. Loudenbeck, chief chemist, Westinghouse Air Brake Co., Pittsburg.
R. S. MacPherran, chief chemist, Allis-Chalmers Co., Milwaukee.
W. G. Scott, chief chemist, J. I. Case Threshing Machine Co., Racine, Wis.
Henry Souther, Henry Souther Engineering Co., Hartford, Conn.
Prof. Thomas B. Stillman, Stevens Institute of Technology, Hoboken, N. J.

Determination of Silicon.

"Weigh one gramme of sample, add 30 c. c. nitric acid (1.13 sp. gr.); then 5 c. c. sulphuric acid (conc). Evaporate on hot plate until all fumes are driven off. Take up in water and boil until all ferrous sulphate is dissolved. Filter on an ashless filter, with or without suction pump, using a cone. Wash once with hot water, once with hydrochloric acid, and three or four times with hot water. Ignite, weigh, and evaporate with a few drops of sulphuric acid and 4 or 5 c. c. of hydrofluoric acid. Ignite slowly and weigh. Multiply the difference in weight by .4702, which equals the per cent of silicon."

Determination of Sulphur.

Dissolve slowly a three gram sample of drillings in concentrated nitric acid in a platinum dish covered with an inverted watch glass. After the iron is completely dissolved, add two grams of potassium nitrate, evaporate to dryness and ignite over an alcohol lamp at red heat. Add 50 c. c. of a one per cent solution of sodium

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carbonate, boil for a few minutes, filter, using a little paper pulp in the filter if desired, and wash with a hot one per cent sodium carbonate solution. Acidify the filtrate with hydrochloric acid, evaporate to dryness, take up with fifty c. c. of water and two c. c. of concentrated hydrochloric acid, filter, wash and after diluting the filtrate to about 100 c. c. boil and precipitate with barium chloride. Filter, wash well with hot water, ignite and weigh as barium sulphate, which contains 13,733 per cent of sulphur.

Determination of Phosphorus.

Dissolve two grams sample in fifty c. c. nitric acid (sp. gr. 1.13), add 10 c. c. hydrochloric acid and evaporate to dryness. In case the sample contains a fairly high percentage of phosphorus it is better to use half the above quantities. Bake until free from acid, redissolving in twenty-five to thirty c. c. of concentrated hydrochloric acid, dilute to about sixty c. c., filter and wash. Evaporate to about twenty-five c. c., add twenty c. c. concentrated nitric acid, evaporate until a film begins to form, add thirty c. c. of nitric acid (sp. gr. 1.20) and again evaporate until a film begins to form. Dilute to about 150 c. c. with hot water and allow it to cool. When the solution is between 70 degrees and 80 degrees C. add fifty c. c. of molybdate solution. Agitate the solution a few minutes, then filter on a tarred Gulch crucible having a paper disc at the bottom. Wash three times with a three per cent nitrate acid solution and twice with alcohol. Dry at 100 degrees to 105 degrees C. to constant weight. The weight multiplied by 0.0163 equals the per cent of phosphorus in a one gram sample.

To make the molybdate solution add one hundred grams molybdate acid to 250 c. c. water, and to this add 150 c. c. ammonia, then stir until all is dissolved and add 65 c. c. nitric acid (1.42 sp. gr.). Make another solution by adding 400 c. c. concentrated nitric acid to 1100 c. c. water, and when the solutions are cool, pour the first slowly into the second with constant stirring and add a couple of drops of ammonium phosphate.

Determination of Manganese.

Dissolve one and one-tenth grams of drillings in twenty-five c. c. nitric acid (1.13 sp. gr.), filter into an Erlenmeyer flask and wash with thirty c. c. of the same acid. Then cool and add about one-half gram of bismuthate until a permanent pink color forms. Heat until the color has disappeared, with or without the precipitation of manganese dioxide, and then add either sulphurous acid or a solution of ferrous sulphate until the solution is clear. Heat until all nitrous oxide fumes have been driven off, cool to about 15 degrees C.; add an excess of sodium bismuthate — about one gram — and agitate for two or three minutes. Add fifty c. c. water containing thirty c. c. nitric acid to the liter, filter on an asbestos filter into an Erlenmeyer flask, and wash with fifty to one hundred c. c. of the nitric acid solution. Run in an excess of ferrous sulphate and titrate back with potassium permanganate solution of equal strength. Each c. c. of N-10 ferrous sulphate used is equal to 0.10 per cent of manganese.

Determination of Total Carbon.

This determination requires considerable apparatus; so in view of putting as many obstacles out of the way of its general adoption in cases of dispute your committee has left optional several points which were felt to bring no chance of error into the method.

The train shall consist of a pre-heating furnace, containing copper oxide (Option No. 1) followed by caustic potash (1.20 sp. gr.), then calcium chloride, following which shall be the combustion furnace in which either a porcelain or platinum tube may be used (Option No. 2). The tube shall contain four or five inches of copper oxide between plugs of platinum gauze, the plug to the rear of the tube to be at about the point where the tube extends from the furnace. A roll of silver foil about two inches long shall be placed in the tube after the last plug of platinum gauze. The train af-

ter the combustion tube shall be anhydrous cupric sulphate, anhydrous cuprous chloride, calcium chloride, and the absorption bulb of potassium hydrate (sp. gr. 1.27) with prolong filled with calcium chloride. A calcium chloride tube attached to the aspirator bottle shall be connected to the prolong.

In this method a single potash bulb shall be used. A second bulb as sometimes used for a counterpoise being more liable to introduce error than correct error in weight of the bulb in use, due to change of temperature or moisture in the atmosphere.

The operation shall be as follows: To one gram of well mixed drillings add 100 c. c. of potassium copper chloride solution and 7.5 c. c. of hydrochloric acid (conc.). As soon as dissolved as shown by the disappearance of all copper, filter on previously washed and ignited asbestos. Wash thoroughly the beaker in which the solution was made with 20 c. c. of dilute hydrochloric acid (1.1), pour this on the filter and wash the carbon out of the beaker by means of a wash bottle containing dilute hydrochloric acid (1.1) and then wash with warm water until all the acid is washed out of the filter. Dry the carbon at a temperature between 95 and 100 degrees C.

Before using the apparatus a blank shall be run and if the bulb does not gain in weight more than 0.5 milligram, put the dried filler into the ignition tube and heat the preheating furnace and the part of the combustion furnace containing the copper oxide. After this is heated start the aspiration of oxygen or air at the rate of three bubbles per second, to show in the potash bulb. Continue slowly heating the combustion tube by turning on two burners at a time, and continue the combustion for thirty minutes if air is used; twenty minutes if oxygen is used. (The Shimer crucible is to be heated with a blast lamp for the same length of time.)

When the ignition is finished turn off the gas supply gradually so as to allow the combustion tube to cool off slowly and then shut off the oxygen supply and aspirate with air for ten minutes. Detach the potash bulb and prolong, close the ends with rubber caps and allow it to stand for five minutes, then weigh. The increase in weight multiplied by 0.27273 equals the percentage of carbon.

The potassium copper chloride shall be made by dissolving one pound of the salt in one liter of water and filtering through an asbestos filter.

Option No. 1.—While a pre-heater is greatly to be desired, as only a small percentage of laboratories at present use them, it was decided not to make the use of one essential to this method; subtraction of the weight of the blank to a great extent eliminating any error which might arise from not using a pre-heater.

Option No. 2.—The Shimer and similar crucibles are largely used as combustion furnaces and for this reason it was decided to make optional the use of either the tube furnace or one of the standard crucibles. In case the crucible is used it shall be followed by a copper tube 3-16 inch inside diameter and ten inches long, with its ends cooled by water jackets. In the center of the tube shall be placed a disk of platinum gauze, and for three or four inches in the side towards the crucible shall be silver foil and for the same distance on the other side shall be copper oxide. The ends shall be plugged with glass wool, and the tube heated with a fish tail burner before the aspiration of air is started.

Graphite.

Dissolve one gram sample in thirty-five c. c. nitric acid (1.13 sp. gr.) filter on asbestos, wash with hot water, then with potassium hydrate (1.1 sp. gr.) and finally with hot water. The graphite is then ignited as specified in the determination of total carbon.

H. E. DILLER, Secretary

USE OF A HEATED FOUNDRY MIXER

By J. B. Nau, New York

In many places, where foundries are located convenient to blast furnaces, the idea of using direct metal from the furnaces, thereby eliminating all intermediate remelting processes with their attendant increasd cost and defects in quality, has been carried out and is practiced today. The practice is naturally limited at least in this country to rough castings and cheap shapes, where the chemical composition and uniformity of metal are of less importance. In the finer grades of castings where more exacting requirements are the rule, the use of direct metal from the blast furnace is excluded, and in many cases, as in cast iron pipes for instance, the remelting of the metal in a cupola or an air furnace is prescribed by specifications.

One of the greatest objections to the use of direct metal is naturally its lack of uniformity, which is not always possible to obtain even in the most carefully managed blast furnace. Could this uniformity of metal be guaranteed at all times, there is no reason why direct metal from the blast furnace should not find a more general application. Surely nothing could be more economical. It was mainly to overcome this difficulty that at the meeting of the Foundrymen's Association, held in New York in June, 1905, the writer recommended the use of a heated mixer as a kind of an intermediary receptacle between the blast furnace and the foundry, into which the iron from the blast furnace could be poured. Kept liquid for any desired length of time, its quality corrected by suitable additions of either liquid or solid pig iron or even wrought iron scrap and from which it could be tapped in such quantities, and at such times as would suit the needs of the foundry.

Today I am in a position to state that the first step in this direction has been taken by our foundry and that other foundries also contemplate the adoption of a mixer.

Last year, the writer received instruction from the general manager of a blast furnace plant to design a mixer for the new foundry that the company is now building in that place, the name of which for the moment we are not at liberty to give. The foundry which will be a most modern one in every respect in the beginning will have a capacity of only 25 to 30 tons of very small castings, but ultimately, and in a very near future, its daily capacity is to be increased to fully 100 tons.

As stated, one of the features of the foundry will be the heated mixer to which the liquid metal from the blast furnace will be delivered.

Owing to the limited output, a high priced tilting mixer with all its attendant operating and maintenance cost was out of the question. It was on the contrary decided to build a stationary furnace of the Siemens type with a short and deep hearth and air regenerators of a capacity considered sufficiently large for the temperature desired in the mixer. To avoid the operation of gas producers and the building of gas flues and valves, oil was adopted as fuel. The rated capacity of the mixer is only 25 tons or about sufficiently large to receive at one time all the iron that the foundry will require in a day's work in the beginning. On account of the very large number of small castings to be made the mixer will have to be tapped and stopped many times during the day.

If only one single tap hole were laid in the lowest part of the hearth, the danger of metal breaking through between two taps would be great. In order to avoid this it was decided to adopt a certain number of tap holes laid at different levels and to draw from the upper tap hole all the metal

that can be taken there before openening any tap hole lower down.

A mixer of a 25-ton capacity is however large enough to supply a foundry of 100-ton capacity and even more, the principal role of the mixer being to receive the direct metal from the furnace in large quantities during the day and while keeping it hot there and correcting its quality if necessary by suitable additions, withdraw it in repeated and smaller taps whenever required in the foundry.

The iron is brought from the furnace to the mixer in a ladle hung from an overhead trolley, thereby avoiding any interference with the yard track.

In large foundries where different grades of iron are used for different castings, the mixer again will be handy. In this case the direct iron from the blast furnace could be stored away in a primary mixer of larger capacity from which it could be tapped to feed two or three secondary mixers of smaller capacities. Each of these could supply one department of the foundry and with suitable additions of either pig or wrought iron scrap, the grade of iron required in that special department could be obtained accurately and with ease.

The mixer now building will not be in operation for some time. We can therefore submit no working data.

THE STEEL FOUNDRY AS A BUSINESS VENTURE

By W. M. Carr, New York

In recent years the steel casting industry has made rapid strides and for many purposes cast steel is gradually and permanently superseding cast iron. The situation is recognized by all engineers as one requiring the attention of leading and progressive cast iron founders. That the steel foundry business is an established industry is incontrovertible and one constantly improving and developing. The pioneers had their failures and losses but ultimate successes are obtainable so that prospective investors in steel foundries will not have thorny paths to travel, in order to get financial returns, as in the early days of the industry. The capitalist has better assurance of dividends than at any time in the past.

Capital.

The first question is, how much capital should be invested for a given output? The answer cannot be particularized because local conditions affect each individual problem, but the following remarks covering the subject broadly will serve as a guide to prospective investors.

Large tonnages of course yield large returns but the net profit on a given amount of capital does not vary directly with the size of the plant. Small plants can show as great a percentage of profit as larger ones. The demand will largely control the size of a plant. To illustrate we will consider a plant yielding 150 tons daily, or 4,000 tons monthly. Such a plant would employ about 1,800 hands, would require a large amount of ground with good shipping and receiving facilities. There should be at least five 25-ton open-hearth furnaces with four of them in regular operation. The furnaces would have to be served with electric charging machines, the molding and casting floors served by several 35-ton cranes. Hoists and light travelers would be required in cleaning, finishing and shipping deparments. It should have a well equipped power house with engines and generators, pattern shop, machine shop, yard loco-

motives, and liberal molding machine installations. Such a plant as described could not well be started without $1,000,000 capital, and the cost of erection of substantial buildings with crane runways and complete equipment would amount to at least $750,000. The following estimate on the basis of ton capacity will cover plants varying from 80 tons per day with a two 25-ton furnace plant to one with five 25-ton furnaces producing 150 tons daily:

Furnaces only	$1,200
Gas producers, gas mains or oil tanks and accessories	600
Buildings, 800 square feet per ton at $1.25	1,000
Power, machinery, cranes, hoists, ladles, drying ovens, etc.	2,300
Total cost per ton	$5,100

Such an equipment with a good demand for casting can show 25 per cent on the investment.

General Practice.

In general practice it is better to have two open-hearth furnaces if a modest plant is desired. Keep one in reserve in case the active one should go out of commission. The larger furnaces, 25-ton capacity, are best suited for heavy castings although some plants run successfully on pieces averaging 30 pounds each. A shop should be designed with a view to the character of work to be produced. If small work, pieces averaging 10 pounds, a small open-hearth furnace is suitable.

Light Castings.

For very light castings weighing ounces, the Tropenas process is in use but it will not reach the development promised by the open-hearth process producing basic steel castings. The pronounced limitations are the heavy losses and the high price of new material. It is admitted by the inventor of the Tropenas process that the loss in melting is 17 per cent, a loss which in comparison with any open-hearth process is wasteful. In open-hearth practice the loss in melting only averages 7 per cent, and under favorable conditions a much smaller loss can be shown. The pig iron for the Tropenas process is imported and is of a special composition and is scarcely used for any other purpose. The pig iron for the basic process is cheap, domestic and plentiful in comparison, and, further permits the use of alomst any kind of steel scrap; the latter material for a Tropenas vessel must be like the pig iron of special composition. The converter process is a comparatively new one and but very few operators can be found who are skilled. Investors who may place their money in Tropenas plants may find greater difficulties in their way than did the early users of the open-hearth processes, before commercial results can be obtained. The Tropenas process however is well suited for special purposes when certain kinds of steel are wanted in small quantities, but for general uses its own weaknesses are detrimental, preventing competition with open-hearth methods.

Basic or Acid Furnaces.

The question may arise as to whether an open-hearth plant should be fitted with basic or acid furnaces. The basic process is cheaper in the first place and the stock for it is more plentiful than for the acid. The chemical analyses of melting basic stock are wide and liberal. Those for the acid narrow and limited. The scrap for the basic process is almost only confined by its shape rather than its chemical composition. The scrap for the acid process is produced in the first instance by a basic process and will be represented by bloom ends, billet croppings, axle butts, plate clippings, etc., and is sold on analyses. It is stated that low phosphorus ores are getting scarce while high phosphorus ores are quite plentiful so in regard to the material from which pig iron is made the basic process has the greater promise. Physically basic steel in castings is just as reliable in every respect as acid steel.

Department for Gray Iron Foundries.

To the gray iron founder who feels the inroads of steel castings in his bus-

iness and recognizes the demand but is not disposed to invest a million dollars in a 150-ton plant, I would like to suggest to him the erection in his shop of an open-hearth furnace anywhere from two to ten tons in capacity. The furnace to be lined with a basic bottom and designed to burn either natural gas or fuel oil. Take as an average size one of five-tons capacity. Such would fit in ideally with existing equipment. Being basic, there would be no need of buying any fancy priced imported stock; any pig iron with silicon below 1.25 per cent, sulphur not over 0.08 per cent, and phosphorus with 1.00 per cent or less can be used and such anaylses would cover some grades of cast iron scrap in the shape of old car wheels, malleable, etc., and charged with 50 per cent of steel scrap such as springs, rails, agricultural scrap, defective steel castings, etc., would give an opportunity to produce steel castings of good quality from low grade stock. Being of of a moderate tonnage there would not be any heavy powered machinery to handle the heats. The only important change would be in regard to molding sand, a special grade being necessary. The basic furnace could be used to put to profit machine shop turnings and borings by mixing them in moderate quantities with the charges.

In some cases it might be advisable to line the furnace for acid melting and if desired it could be used for turning out "air-furnace-iron" heats.

Cost of a Small Furnace.

A five-ton furnace, basic lined, erected in an active iron foundry, would cost about $6,000, and allowing $4,000 for special bottom, pouring ladles, oil storage tanks, burners, etc., the total would be $10,000 exclusive of buildings. It would be capable of producing three heats daily and would yield 12¾ tons of castings at the rate of 15 per cent in melting loss, gates, heads, skulls and defective castings, an average yield in a well ordered plant. Producing such tonnage steadily should show good profits. The single furnace however, has the disadvantage of going out of commission for repairs. It should turn out 400 heats before a general overhauling, or say a run of 133 working days. Assuming that the furnace was only productive nine months of a year at 25 working days per month, there would then be 225 days yielding a total output of 2,868¾ tons of product. Allowing an average profit of one-half cent per pound, there would be a gross profit of $28,687.50 annually.

But losses will arise in spite of best intention and not to make the venture look too roseate the set-backs will be considered which might be caused by breakdowns, strikes, or errors on practice. These conditions might reduce the good castings to one-half of the metal charged so that 7½ tons were the output. With the same productive period of 225 days per year, and with a decided shrinkage, because of losses, between manufacturing costs and selling prices so that the gross profit was only one-eighth cent per pound, the tonnage per year would be 1,687½ tons, and the returns therefrom $4,218.75. Out of this 25 per cent can be deducted for interest on the investment, depreciation, etc., there would remain a net profit of $3,164.07, which is equivalent to 31.6 per cent on the original $10,000.

The estimate in this case is very conservative and the low yield is an extreme. With careful practice the results can be made better than shown. There will be pitfalls and irregularities but they will be greater in a large plant because greater units are concerned and heavier risks. The small furnace will be profitable as well as the large one and should times be lean and the demand fall off the small plant can bear the brunt as well as the bigger one because of the smaller amount of capital involved. There would not be in the small plant a top heavy organization to maintain or the demand for dividends to be met.

Profitable Investment.

A steel foundry in prosperous times is a good earner, but because it is a

steel foundry with great possibilities, like any industry it is not devoid of conditions of a negative character. An open-hearth plant with basic furnaces or acid furnaces does not have to pay patent royalties. The former type of furnace can take impure stock and refine it to steel. In that respect it has flexibility and a promising future. The acid process requires special composition stock of a limited nature in the market. The converter process requires skilled operators hard to find; has heavy melting losses, requires high priced stock differing some from open-hearth acid stock in composition. The crucible process does not refine but simply remelts the product of the basic process in the shape of waste material. There are other evidences in favor of the basic open-hearth process as meeting the needs of a growing industry and the foregoing points mentioned are to be taken into consideration when looking into the question of engaging in the manufacture of steel castings.

THE GRAY IRON FOUNDRY AS A BUSINESS VENTURE

By Thos. D. West, Sharpsville, Pa.

Our secretary, in requesting this paper, stated that he desired the writer to describe what a man embarking in the gray iron foundry business, should know before he begins; what methods to pursue after he has decided to start, and what obstacles he is likely to encounter. Each sentence forms the text for a paper in itself, but taking the first, the main point which should be considered in starting a foundry, we have the following:

First—The great lack of good skilled labor.

Second—Influences retarding the training of a plentiful supply of skilled mechanics.

Third—Independence and insubordination of many of the few skilled and respectable men available that may be obtained after extra inducements are made for their services.

Fourth—Difficulties and losses arising from trying to do work with the riff-raff that a starter is compelled to employ in beginning operations.

Fifth—The slow attainment of discipline and organization in a shop's working force.

Sixth—Losses through defects developed in machinery and tools caused by trying them out and bringing them into good working order.

Seventh—The advantage that sellers of appliances and purchasers of castings take of ignorant beginners.

Eighth—Extra risks with consequent losses by accidents incurred through the want of experience in operating machinery and shop appliances.

Ninth—Difficulties in obtaining practical and good executive managers and foremen.

Tenth—Losses and embarrassment caused by the narrow range of vision of hired managers, as compared with that of the man who may have his all at stake striving for a foothold.

Eleventh—Inability of proprietors, inexperienced in actual molding, mixing and melting, to avoid mistakes in getting the best managers and foremen, the windy blow-hard being often better liked than the one of true merit because of inability to rightly judge.

Twelfth—The underestimation of the obstacles and uncertainties that every beginner must encounter.

The twelve points just given are as a whole encountered much more in

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brisk than in dull times, and in times of very great prosperity can be the means of driving the most experienced workers and financial managers to the wall.

A beginner's fight to exist can be such, even with sufficient working capital, that he is brought to the point to despair of success by reason of the great odds and seemingly insurmountable difficulties that will confront him.

The difficulty of obtaining good overseers as well as skilled labor, which is most pronounced in good times, is alone one of the twelve factors that demands more consideration than a reasonable working capital, and often knocks out the best of experience, good management and hard work.

We could take up every one of the twelve points and fill a number of pages with a discussion of them, but will let it go with the simple statement. Aside from the great need of skill, the general public's great lack of comprehension as to the demands on skill and experience needed by our molders in connection with the making of castings is about the next greatest evil to injure many starters and the trade in general. This poor conception that the general public has of the foundry business has caused many novices to undertake the work and there is one instance that recently came to the writer's notice in which a bookkeeper who never lifted a rammer put all his hard earned money into a small foundry and hired a farm hand to run it for him while he maintained his salaried position. This new foundry owner was a bright and modern financier and when his working capital was exhausted he did not close his shop until he had involved others in his downfall.

There is one feature difficult to comprehend and that is the great difficulty of making men inexperienced in the business realize its hazard as well as the fact that skill is required to make good castings. Of course almost any fairly intelligent man can make a good casting, of almost any character, allowing him time to experiment, and where there is sufficient capital and cupola capacity to keep remelting his bad castings. Few beginners, however, have sufficient assets to support this experimental work.

The novice's inability to understand the requirements for making good castings at the first pouring is such that even men that can successfully make small and medium castings day in and day out believe they are competent to be trusted with the making of most any heavy castings. When this belief can be found so prevalent, as it is with molders throughout the world, is it any wonder that many who have walked through a foundry a few times get the idea that all is easy, and that nothing else is required than a few patterns and sufficient muscle to pound sand, under the control of an intelligent business head to make a foundry pay, ever forgetting that intelligence is one requisite, and experience another.

The question of the methods a man should pursue, who has decided to start a foundry is answered as follows:

First—He should make a thorough investigation to discover if there is a demand for the class of castings he intends to make, and what competition exists.

Second—The selection of a site that will be central to his market, and in building to start on as small a scale as practical, but planned for extensions that can be carried out without tearing down too much of the existing plant.

Third—In the search for machinery and appliances he should endeavor, as far as possible, to get the experience of others. The A. F. A. convention should be visited for its information and its exhibits inspected to note and investigate the latest improvements.

Fourth—In buying machinery and appliances he should avoid, as far as possible, the purchase of second-hand tools. The new has all its life, whereas the old is more or less worn out, and will not as a rule give good service for the money expended.

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Fifth—One seeking orders, and not competent to quote prices, should not be ashamed to seek his manager's or foreman's advice.

Sixth—In starting to make castings don't be in a hurry to fill your shop with work. Go slow, feel your way, and your chances for error or failure will be greatly decreased.

Seventh—Be sure to have sufficient working capital and good chances of obtaining a surplus over and above what is considered necessary.

As to what a man should know before he begins is rather a broad question to ask an experienced founder, with the expectation of getting any answer other than that he learn to be a thorough molder as well as a business manager. No man who intends to be at the head of a foundry can be too thorough in the actual work of molding, mixing and melting, and he should have executive and business qualifications.

There is no trade demanding so much skill and experience wherein so many enter who are wholly deficient in practical knowledge of its operations as the foundry business. It is a case of the many trying to make two wrongs make one right, and because some learn of an inexperienced man having made a success of his entry into the field they think they can do likewise.

Thirty years ago, few, if any, ever thought of going into the foundry business if they were not so practical that they could discharge any molder and take hold of his work in a more masterly manner. Today we find bankers, lawyers and even clerical men who have assumed the management of foundries. We must ever remember that brains and intelligence do not stand for experience. If the day ever comes when practical education is given greater recognition, we will have the best that is possible in the foundry president or manager, as well as in the employe, but not before.

EVOLUTION OF THE FOUNDRY BUSINESS

By Edw. B. Gilmour, Elizabethtown, Pa.

In entering upon a discussion of the evolution of the foundry business it is unnecessary to dwell at any great length upon its early history as it was not until comparatively recent times that the foundry business was given any practical study. Everything cast was formerly made in brass, it being fusible and of a pretty appearance. As a consequence a great variety of products were made of that metal, and we have records of some early castings that are almost beyond belief. If these castings were wanted today it is very questionable if any founder would care to run the risk of making them unless at a large margin, the customer assuming part of the risk.

Among these historical castings are the two columns cast by Hiram of Tire for King Solomon's temple. These were 27 feet long and 4 feet 6 inches in diameter, and weighed about 175 tons. It is also recorded that the Greeks and Romans were experts in the molding of statuary, having had a circus adorned with no less than 3,000 statues of bronze for the time of the Circinsian games.

It was not until the seventeeth century that the casting of statuary was better known by us. Authorities agree that it was in the fourteenth century that the first gun was cast. As to bell founding we have a record as far back as 400 A. D., of castings made at Nola in Campania. The largest bells have been cast in Russia. In 1736 there was one cast in Moscow weighing 250 tons, the largest in England is only 15½ tons,

and the largest in this country is in Montreal and weighs about 13 tons. Milwaukee has one weighing 10 tons.

The art of bell founding is very simple as regards the molding, and there has been no progress in this line. With the usual spindle and sweep, any desired shape and thickness can be secured. It was not until the beginning of the last century that the iron founder asserted himself, and it is only since the introduction of the steam engine that any real progress has been made in the foundry business. Now it has reached such a state of perfection that no matter how complicated the article, it can be made.

The introduction of the marine engine has stimulated great ingenuity in the production of heavy and intricate castings. I well remember that when a large cylinder was to be cast it was not uncommon to have it made over the third time before it was accepted; whereas at the present day it is as much as a molder's reputation and position is worth to have a single blemish upon it. This is the advantage of specializing in the foundry.

Nevertheless it has been truly said that every foundryman should have some knowledge of chemistry; especially, that related to his work. It is not so essential to know what an iron contains as it is to know how to utilize the different constituents to the best advantage in the various classes of work required. Theoretical knowledge is of very little value to the foundryman without the practical experience, as great care and watchfulness are required to insure success. The exactness of our art is unlike that of any other. One must follow regular laws, and one small variation will destroy all the work in one minute which may have taken weeks to produce. Very little has been done in the way of machinery for molding, all the appliances simply being designed to help the skilled molder whose mind has to be kept continually at work in order to keep up with the requirements.

While the engineer has been making rapid progress with the steam engine for transportation purposes, and has compelled the foundry to be based on science, the founder of specialties has not been behind in his endeavor to produce castings in quantity and of quality, and with the duplication of so many parts the ingenuity of the designer of molding machines has had splendid results, increasing the output enormously and improving the quality. The molding machine is now an indispensible factor in the foundry.

Since the introduction of metal into the patternshop there has been a tendency to do away with the regular gated patterns and to substitute aluminum and other metal webs which do away with sand matches and the breakage of gated patterns. The webs are practically indestructible, and when the patterns become obsolete, one has the value of the metal for other patterns.

While the designers of molding machines have made rapid progress, they have never been satisfied with their work, and in consequence, at every convention, we have been surprised by something new in this line. We have had the indispensable stripping plate machine which produces a most perfect casting but we must yet dispense with much of the hard work required in ramming molds. Power rammers of various kinds have been adopted such as those working by steam, eccentric pressure, jolting, etc., which have been applied as a rule to special work. This year we have an innovation in the way of a molding machine which I predict will extend the machine molding business as the gravity principle has been applied in a new way. This system has been attracting considerable attention for the past three years in different sections of the country. Mr. Anthes, our vice president for Canada, has made some valuable experiments along this line which have been very successful. At the same time in the far south and middle west other men, unknown to each other, were experimenting along the same line.

The method is taken from the fact that the most intricate kind of ram-

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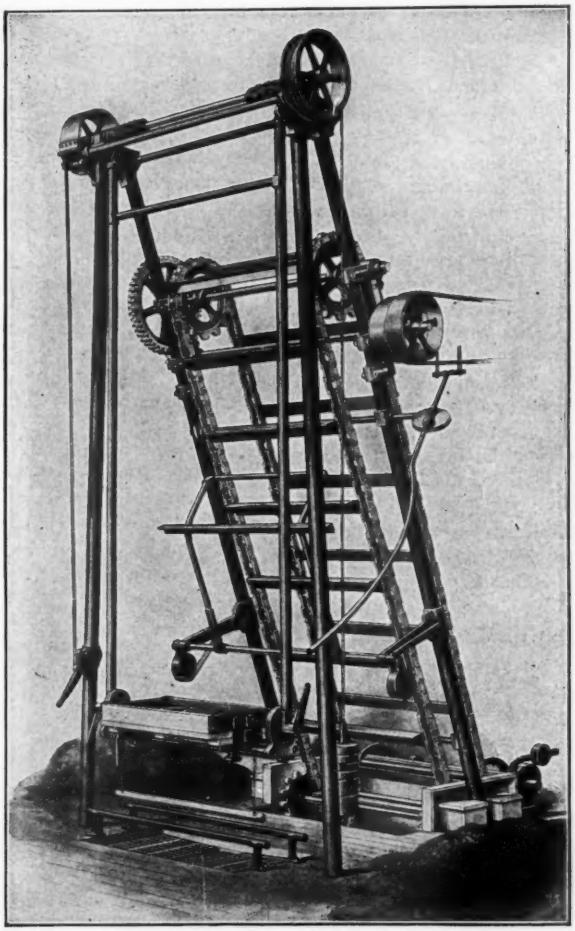
ming is accomplished by riddling the sand at one side and throwing it into the intricate parts of the mold. For instance, a gear wheel can never be rammed successfully in the teeth with a rammer. This principle is now carried further and applied to every part of the mold in the form of a machine called the gravity molder, shown in the accompanying illustration. One other good feature of this machine is that one can adopt a special flask the full size of the machine. We have adopted a standard size, 3 feet by 4 feet with a 5-inch cope depth and a similar drag, with bars bolted in. One can put any number of sections together to get any required depth. With the stripping plate attachment good and rapid work can be done, the greatest difficulty being the handling of molds as fast as the machine produces them.



GRAVITY MOLDING MACHINE

This is the latest development in the art of molding and is based on the successful application of the force of grav-

ity. Most of the experiments have been based on the theory that the greater the distance the sand has to fall the harder it will pack in the flask. Experience has demonstrated, however, that the reverse is the case, and that the mere dropping of the sand into the flask does not serve to pack it, and the greater the distance it is allowed to fall the less it will pack by reason of the increased tendency to scatter or disintegrate while falling through the air.

The inventors of this machine discovered in their experiments that to successfully utilize the force of gravity the essential requirements are first in forming separate unitary bodies of sand of the proper size and shape and degree of firmness, and the discharging of these bodies from an elevation sufficient to cause them to pack together in the flask by the impact of the fall. When these separate bodies of sand are properly formed, it is only necessary to have the fall a comparative short distance to accomplish the desired results.

It has been found in practice that to make successful the gravity method of molding it is necessary:—

First—To form the sand into proper size and properly shaped bodies.

Second—To compress these bodies to a considerable degree of firmness before their discharge into the flask.

Third—To discharge a series of these compressed bodies into the flask from an elevation not great enough to cause the sand to disintegrate or scatter, but at the same time of sufficient height to cause the same to pack firmly and uniformly around the pattern.

While the above indicate the first essential requirements in successfully utilizing the force of gravity for machine molding, at the same time numerous problems of minor importance were met with in perfecting a machine that would perform all the functions necessary to meet these requirements. This has been accomplished in the Gravity molder which makes use of a simple mechanism for forming, compressing and discharging, from a sufficient elevation, elongated bodies of sand, or compact and separate strips of sand, each body being long enough to extend full width of the flask in one direction, and of such thickness that a series of these bodies falling into the flask side by side are required to form a layer of sand across the flask in the opposite direction.

In other words, by the gravity method the flasks are rammed by a succession of compressed bodies of sand falling and wedging beside each other until a layer is formed across the entire area of the flask, after which additional layers are built up in the same manner until the entire mold is formed in one solid mass of sand of the same degree of firmness throughout.

With this method of ramming it is unnecessary to vent the mold, as there are no hard spots caused by the rammer, and it leaves the sand in a free but solid condition in the mold.

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A FEW DENATURED BRASS FOUNDRY NOTES

By Wm. H. Parry, Brooklyn, N. Y.

To melt copper with a little tin and spelter or lead added on the side, can be accomplished by most anyone who has metal, fuel, oxygen and patience.

To melt any of the non-ferrous alloys however, in a manner calculated to insure economy, combined with the best results, calls for no little skill, as anybody addicted to this habit can testify.

For the man who attempted to color his mixture of 90 spelter, 6 copper, 2¼ tin and 1¾ lead, with four quarts of the 57 varieties of tomato soup, there is no hope, neither is there any room in heaven for the men who will persist in trying to achieve known results from unknown quantities and qualities of ingredients, as well as unknown pouring temperatures and fuel properties.

To properly melt brass or bronze is a trick not to be learned in five minutes, for the very excellent reason that conditions vary greatly, and what might be the correct fuel and temperature for one class of castings would not be at all suitable for others. While it is practically impossible to lay down set rules for the guidance of melters in general, it may be well to cite a few instances that will at least prove that one is never too old to learn.

A Few Experiences.

After many unsuccessful attempts to pour a certain casting of peculiar design, from metal melted in an oil furnace, it was found that when the ordinary floor crucible furnace using coke as fuel was used to do the melting, the resultant casting was good, thus proving that for thin castings covering a great area, and of broken or staggered section, the oil furnace cannot be used successfully, because of excessive oxidation, which traps the metal before it can flow to the outermost recesses of such a mold, which in this case was dry sand,—the most favorable condition. Now, the deductions from this instance are easily arrived at; first, oxidation due to method of melting, as air at 18 ounces is admitted in constant volume for from 60 to 90 minutes, according to the weight of charge, with resulting non-fluidity, though it is possible to have a melted metal very fluid, yet with a proportionately greater affinity, either forced or natural, for oxygen, in which case poor castings will occur with distressing frequency, no matter what may be the design or the deoxidizing agent used.

At another time it was desired to cast an order for pump cylinders, 88 copper, 10 tin and zinc. After losing five castings in succession—though outside indications were favorable—the melter's method was looked into, and it was found that he was more fitted to mix mince meat at a bakery, as he believed in melting the whole mass as one, and not adding his tin and spelter at the proper time.

The trouble here was porosity, and it was not altogether due to the ignorance of the melter at that, as the pouring temperature was too high, and when both the melting method, and temperature were regulated, the castings made were perfect. Again it is possible to pour metal at too low a temperature, either from insufficient time in the cooking, or waiting too long after the cooking thereof, porosity again being conspicuous, even more so than from overheating. No less an authority than Percy Longmuir states, that, assuming the mixing and melting of alloys to have been thorough, the success or failure in casting is entirely a matter of the pouring temperature.

Wedge Test.

A very practical and interesting test for fluidity, proper casting tempera-

ture, and the necessity for or the non-use of risers, is the wedge test. Have a wedge pattern made, say half an inch thick at one end, to nothing at the other, fifteen inches long, and about two inches wide, gated at the butt end. Cast the same on the flat from metal melted in any oil furnace, and one from the ordinary floor furnace, using crucibles and coke fuel, assuming the temperature at pouring to be same, it will be found that the crucible metal will have run much closer to the point than the other, thus proving to be more fluid.

Again make two molds from same wedge pattern, arranged to be cast on end—point up—and gated at the lower or butt end. If too hot the casting will show that while the metal could climb up, it could also "eat in" even at the point, while if too cold it could neither climb nor eat.

By making the wedge castings both with and without risers, and placing molds at different angles for pouring, the results point invariably to the necessity for the use of risers on all classes of work, though it must be said that proper venting is an essential not to be despised.

It is hardly necessary to explain that these inexpensive test molds, to be conclusive, should be made with sand taken from the same heap, and in every way to be tried with fairness.

Metal Patterns.

The making of metal patterns in this age of molding machines has assumed proportions little dreamed of but a few years ago. Many articles published in the technical press have enthusiastically advocated the use of aluminum as the ideal metal for use as patterns, even going so far as to state that in addition to its lightness the surface presented to the sand was vastly superior to any other metal. Now this all sounds and looks good, but an experience of eight years with this metal as used for patterns compels the statement to be made that it is both a delusion and a snare any way you look at it, either as a pattern metal or constituent in alloys.

Use of Aluminum.

As a pattern metal, when it is claimed that the metal is easily handled because of its lightness, all of its good qualities stop right there, as in addition to being hard to cast properly, owing to abnormal shrinkage and oxidation, it is probably the very worst metal known to turn, plane, file or scrape, and if after three times as much time is spent on the patterns than would be the case if good red brass were used, we have patterns that are to be a fruitful source of annoyance while in use. The surface is readily attacked by the molding sand, and becomes in a very short time about as smooth as number two sand paper. The effect on the castings from such patterns can better be imagined than described.

Aluminum as a constituent in non-ferrous alloys to add tensile strength is to be avoided, no matter what the makers claim for it, as practice has taught us that while it certainly does increase the tensile strength of the copper and brass mixture approximately to that of steel (if you can find a sound part of the casting to test), yet the difficulties encountered in producing sound castings, such as oxidation, shrinkage and the necessity for a pouring head of sufficient volume and height to feed the mold, removes it as a possible factor in the successfully conducted foundry. Until some practical process of pouring molds in a vacuum is invented, it will be good policy to shun the use of this metal, yea even to scrutinize and analyze the scrap we buy for its presence which, even to the one-hundredth part of one per cent, will make trouble for any foundryman if he doesn't know it's there.

Eastern Practice.

It is a fact worth noting that here in the east at least, brass foundrymen are prone to use iron flasks on work that could readily be handled by snap flasks. When one sees foundrymen making shallow and light castings in iron flasks, and a couple of 30-pound weights on top of the mold, it's enough

to make Rome howl, yet this is entirely true of the practice in this part of the country.

This is a matter worthy of the attention of brass foundrymen, as it is beyond question that at least 50 per cent of tub molds could be made in snap flasks successfully, and with economy.

To carry economy further, the use of carded patterns on repetition work coupled with snap flasks very often produce results that equal some molding machines in speed, and excel them in the quality of castings, this being explained by the fact that the snap molds were hand rammed and facing sand was used.

There are many other peculiar practices prevalent in our brass foundries, but now that the brass foundrymen are getting together it is highly probable that advancement will date from the present, and up-to-date knowledge will be spread broadcast for the benefit of such brass foundrymen that need it.

CAST THREAD FITTINGS

By Henry B. Cutter, Seneca Falls, N. Y.

When the request of your secretary was received to present at this convention, the subject of making gray iron castings that did not require machining, it was stated that foundrymen throughout the country were much interested in the subject. While acceding to the request, it seemed almost presumptuous on my part to undertake the presentation of such an important subject, particularly as your orator's experience in foundry work covers a period of less than four years. I have been assured, however, of your kind consideration and friendly criticisms.

The principle and method of making gray iron castings with threads cast in them was evolved by George Cowing, of Cleveland, about 1878. The development of castings thus made was coincident with the development of the pump industry in which Cowing & Co., Seneca Falls, N. Y., were leading factors. This method of making castings with cast threads was applied to the manufacture of pumps where different parts were to be screwed together, and was employed exclusively by this company in its works from the time of its inception to the practical abandonment of the business. It was found to have been a marked point of economy in the manufacture of pumps, and enabled the manufacturers to produce superior goods.

The making of gray iron castings with cast threads was for many years an incident correlated to the manufacture of pumps, but since the organization of the Cast Thread Fitting & Foundry Co., the making of gray iron fittings with cast threads has been carried to a much higher degree of perfection than had hitherto been thought possible, both as to quality and economy in methods of production.

Recent tests with a number of these fittings screwed together with wrought iron pipe having standard gage cut threads, the joints having been made up without the use of any dope other than lubricating oil, showed no indication of break-down under a pressure of 900 pounds to the square inch.

Erroneous opinions have existed among foundrymen in general regarding the method of producing castings with the threads cast in them, as it had been considered by many that it was done by the use of chills, thereby producing a hard brittle thread which would be liable to break in making up. This method, however, has not been employed.

The method pursued in making cast threads in gray iron fittings has

been by the use of seamless sand cores formed without the fin or rib that is usually caused by the sections of a core box and which require dressing off. The thread of these seamless cores are formed in the sand by the use of special devices. The dies of the thread forming devices are made of high grade steel and are subjected to a minimum amount of wear. When once made to standard gage they will produce duplicate thousands of these seamless thread cores without variation, and being thus made, are perfectly round.

The seamless thread cores are then joined with the ordinary plain or body cores by the use of arbors, and are placed in the mold the same as ordinary cores. The special mixture and the fineness of the sand from which these thread cores are made, produce a clean sharp thread in the casting. The methods employed in uniting the thread cores with the plain cores are such, under improvements recently put into operation, as to render it impossible for the threads in the castings, where they come at opposite ends of the fitting, to be out of alignment.

It has been claimed that the contraction of the metal from the time it is poured into the mold until the cooling of the casting would produce sufficient shrinkage to render the making of cast threads unreliable and variable. Such a condition, however, does not exist in practice, and is perhaps due to the fact that the solid core prevents a shrinkage which might otherwise occur. The metal in the threads of castings thus made is of the same structure as that in the body of the casting, only having on the surface of the thread a thin film present on all gray iron castings. This film proves to be of great benefit in practice, as it is harder than metal where the film is cut away, as is the case with standard threads cut on pipe. This cast thread being standard, true to gage, and possessing the hard film of the casting, forces the cut thread of the pipe into a perfect union.

Regarding the iron used in making gray iron castings with cast threads, ordinary foundry practice is pursued, care being exercised in the mixture of the iron, which, when carried out by the usual methods of mixing by analysis, produces clean, sharp threads.

A PLEA FOR THE APPRENTICE

By Wm. Gebb, Jerome, Arizona Territory

The cry of the times in foundry circles is constantly and urgently for more and better trained molders. Where can you begin to more advantage than with the apprentice?

Give him instructions not only in a line of molding, but in all classes of work that comes to your shop. Let him learn coremaking; show him how to manipulate the cupola, the brass furnace, in fact every branch of the trade. Then when your melter or coreboss is off, give him a chance to try his hand in these lines. You have given him responsibility in this way, even if only for a day, and you will be well repaid for it.

The time when all hands laid off because the "Czar" of the furnace did not show up is past, and there is no foundry today but that can swing in someone to fill the gap for a time at all events.

I can only reiterate that we need more high-class mechanics, and we need more all around journeymen. What more satisfaction can a foreman have than to have one of his apprentices called to manage a foundry somewhere and to have him unhesitatingly accept

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the responsibility and succeed. What foundry owner, though he may miss his foreman sorely at first, but that is pleased at his employe's success, if he but leaves him in friendship and probity.

So our watchword should be, education all the time and everywhere. It is only a question of time in any shop when attention to the intellectual side of men whatever the post they fill, will amply repay itself in better results, greater loyalty, and lasting benefits to the community.

THE DESIGN AND CONSTRUCTION OF FOUNDRY BUILDINGS

By Geo. K. Hooper, New York

The foundry business has become so specialized and such rapid strides have been made in the elementary knowledge of the methods and requirements of manufacture that it is difficult to make any general remarks on the subject of foundry construction. I will, however, endeavor to describe some of the plants which I have designed and which comprise foundries devoted to the casting of the smallest forms of large sections with practically no core work, to the most specialized shops using machines almost exclusively.

For plants engaged in heavy work I have made designs in two ways. In one instance, owing to the form of the site and the location of the railroad tracks, it was found advisable to place the stock house and melting equipment at one end of the foundry permitting all of the other operations to divide from that point as a basis. For this shop a straight open building, three bays in width, was built, the second bay having been provided with cranes of sufficient capacity to handle the largest ladles, as in this case the work was such that the ladle of iron was the heaviest thing to be handled. Single rail electric travelers were also installed in the main and side bays, provided with suitable wedges to facilitate their movement from one department to another. In addition to serving the foundry these trolleys were used for cleaning up and for conveying scrap, sprues, gates, etc., from the foundry to the stock house.

The melting equipment was in the middle of one end of the foundry and was separated from it by a brick wall. The spouts of the cupolas projected through the latter and were adjustable so that large or small ladles could be filled at any distance from the furnace. The brick wall also kept the slag fumes out of the foundry and the drop was likewise confined, which made the work of cleaning up comparatively easy. The cored and small work was done close to the cupolas, while the large work, on which the temperature of the iron could vary considerably without affecting the castings, was placed where most convenient. It is unnecessary to state that such work as required the use of cranes was done in the middle bay.

Cleaning Department.

The cleaning department was located at the end of the building opposite the cupolas, partly in the center and partly in the side bays, the design being such that as the foundry increased its output the building could be increased in length and the cleaning equipment moved along to provide additional molding space. With the growth of the plant in view, mills, grinders, and the sand blast machine were placed as far down as possible, that they need not be moved until the second extension to the foundry was made. The contour of the site was such that the waste material could be moved out of the side and end of the shop for filling purposes.

Owing to the peculiar location of the railroad tracks, the stock house was placed across one end of the building and the track was extended up to the charging floor, making it possible to unload several carloads of coke and iron on to this floor. The space underneath the trolley was utilized for the storage of iron, coke, sand, fluxing material, etc., and the whole was enclosed by a like building which contained a single rail electric traveler for handling material to the cupolas and the foundry, and which connected with the trolleys in the latter.

Main Building.

The main building was of steel frame construction, with brick curtain walls, and was provided with a wooden roof covered with slag roofing and with large, wooden frame sliding sash windows. The floor of the foundry consisted of molding sand laid on filling, although no pit work was done. Ventilators with tilting sash operated from the floor extended practically the width of the center bay, and while there were no skylights, sidelights were depended upon for all of the illumination, the windows having been carried as high as possible for this purpose. Large galvanized iron ventilators were placed in the roof at every other bay, to provide for the circulation of air when not pouring and in inclement weather.

The foundry was about 350 feet long, and if it were increased in size to make other melting equipment necessary, the cupolas would be installed at one side sufficiently far down to conveniently distribute the iron according to the varying classes of work to be poured. It is not probable, however, that this will be done, as there seems to be no reasonable limit to the distance which a ladle of iron for heavy work can be carried.

Foundry for Machinery Castings.

A foundry of another type for the production of medium and large machinery castings, with a fair proportion of cored work, was laid out partly in accordance with the contour of the site on which it was located, due regard being given to the location of the railroad tracks. This foundry was of the usual three-bay type, having one large center bay and two smaller ones on either side. The stock house was placed at one side of the property adjacent to the railroad track and contained all of the raw materials except the iron, which was carried in the yard commanded by a crane. The stock house has an elevated track extending through it, that all supplies could be dumped by gravity from the cars in which they were received and thereafter conveyed under cover into the foundry. This stock house need not darken the side of the foundry which it adjoins, since it can be located far enough away to permit the placing of windows down to a level about seven feet above the floor, with a light well at least twelve feet wide. In any event it makes little difference whether the light is somewhat obstructed on that side, since the melting equipment occupies some of it, and with a foundry for this class of work there are core ovens, drying ovens, sand mixers, core storage, coremaking, and other departments which do not require much light, while others can be suitably lighted by skylights.

The coke is raised to the charging floors on cars by means of a plunger elevator, while the iron from the stock yard is carried by a single rail traveler directly on to the charging floor.

Both the melting and cleaning departments are fixed points in this scheme, the foundry with its stock house and yard growing away from these departments, and additional melting equipment can be placed in the side bay if required.

Cleaned castings are stored in a yard or building at right angles to the foundry, communicating with the machine shops. As there is considerable core work a large amount of refuse has to be elevated by cheaply built conveyors to a set of overhead bins, discharging into cars or wagons.

Since a foundry of this type will have some pit work, the flooring will naturally consist of sand to a considerable depth

with brick or concrete floors in the cleaning department. The cleaning floor space will absorb some of the molding room as the foundry is extended, but otherwise this department will not be disturbed.

This type of plant presupposes a large establishment divided into departments, castings being made at the option of the foundry rather than in response to some demand from the machine shops. This plant is to be built with masonry walls having a wooden roof covered with slag or gravel, wooden window sash, partly sliding and partly tilting, large monitor with tilting sash, galvanized ventilators, core room partitions fire proof, and with floors in front of the drying ovens and the core room of concrete construction.

Foundry for Chilled Castings.

Another type covering several classes of large work is designed to grow in two directions, being devoted to a large amount of chilled work. The melting equipment, including air furnaces, is located in the center of the building, and the space immediately in front is occupied by the ladle and chill storage and ladle mending departments. Inasmuch as the molds for the sections made in this plant are cast on end, a proportionately greater tonnage can be secured from a limited floor space, as compared with a plant where floor molding is done exclusively. Considerable room is required in a shop of this kind for handling ladles. Separate power cranes are also required for each pit and liberal head room is necessary. The floor about the pits in front of the drying ovens should be made of concrete. The growth of the other end of the plant devoted to the production of general castings will be similar to that of the large foundry already described.

Arrangement of the Plant.

A plant of this kind may be divided into three or more bays, the furnaces being so located that they are accessible to the main bay cranes. The stock house and iron storage may be located as previously explained. The charging floor, on account of the cupolas necessary to supply all of the mixtures required, should be served by an overhead crane which can carry large pieces of scrap and carloads of pig iron to any cupola or furnace.

While the area required per molder in lighter gray iron work may be as great or even greater than in heavier work, the tonnage handled is proportionately much smaller. Frequently no overhead equipment is required, tracks or trucks being amply sufficient for handling the iron. Certain floors may require comparatively large amounts of iron and separate handling appliances, but in general the buildings will be divided into bays, with the melting done at one end or one side and the cleaning department directly opposite. The pickling department should be located away from the natural line of growth so that extensions will not disturb this department. For this class of work the core room can be established at a distance from the foundry and it is not essential to have it directly in or adjacent to the foundry building.

The stock sheds and iron storage should, of course, be convenient to the melting department and the overhead crane is not essential to the iron yard. Tracks and cars connecting with the elevator are as economical as a yard crane, when all of the handling is considered. A separate building should also be provided for the storage and repair of molding machines.

In a foundry of this type it will be found necessary to install light overhead travelers which can serve either the molders or the machines and which, in any event, can handle the iron. Considerable space is also necessary in a plant of this kind for stacking flasks, as it is not practical to have a large flask yard or to build a separate structure for them. Galleries can be used very well as storage room.

Plants Equipped for Special Work.

Foundries equipped with machines for special work will next be considered. They can be built several stories in height with a foundry on the upper floor and the other departments underneath; or where there are a number of foundries in a group, the buildings should be two stories, with a foundry on the top floor. The various foundry buildings should be located so as to conveni-

ently receive their supplies from one stock house and their cores from another, with a pattern storage and repair department over one or the other of these buildings. The buildings should be designed with sufficient head room in the lower story to accommodate large tumbling mills with a platform over them for suitably distributing stock, the mills being high enough to dump their contents either into barrels or onto conveyors. A floor should also be provided for the foundry with a frame for a suitable grating through which the sand can be dropped and on which castings can be piled after shaking out.

The roof should have sufficient strength to support travelers for carrying the molds and iron, and all bracing should be kept above the trusses as far as possible to provide for conveyors for handling sand to the molding machine hoppers. The trusses should be designed with a stiff lower chord and should be of such form that the apparatus may be fastened to it anywhere without punching or drilling. A durable floor can be made of paving brick laid on planks with a cushion of sand, the planks having previously been covered with a waterproof material to prevent dry rot. A floor of this kind can be changed for any purpose more easily than one of steel or concrete and is furthermore much lower in first cost.

The castings are dropped through chutes in the floor to the mills below, where the sorting, cleaning and grinding are done, although a certain amount of sorting can be done on the foundry floor by judiciously locating the machines on similar work.

Continuous Work.

Plants for highly specialized work, involving carriers for handling molds, flasks, castings, etc., will next be considered. There are two types, one with the building two or more stories in height, with a carrier on the upper floor, while the other has the carrier and the other departments on the ground floor. The price of the real estate and the size of the cores largely govern the design of a plant of this kind, as the output is large in volume and must be handled by conveyors, and there is little advantage in the use of gravity.

I have built plants of both types and have found either well suited for the work for which it was planned. In one case the core room and core storage were located so that the cores for all classes of work could be placed on the carrier with a minimum amount of handling and each car of the carrier brought a fresh core to replace the one taken away. All departments, including the cleaning room, were on the ground level. Such a plant requires a large amount of light and ventilation and windows and skylights are placed wherever possible. The floors are preferably of concrete, as practically no sand collects upon them and as the pouring is done while the flasks are in motion on the carrier, there is little danger of spilling or splashing iron. In another plant producing very small castings the carrier was placed on the second floor and the finished sections were delivered by means of a conveyor through a separator and cooling tank to a continuous cleaning apparatus on the first floor. The cores were handled in trays.

The roof of such a foundry should be very heavy and substantially braced in all directions, as it must support considerable overhead conveying apparatus for the handling of sand with concentrated loads at various points where the sand happens to be located. The floor should be of brick or concrete, preferably the former, for reasons which I have already given. There are no great floor loads with carriers, but a complicated flooring system is usually necessary on account of many conveying devices which are used. In the construction of buildings brick walls, either with or without steel columns for supporting the trusses, have been used.

Types of Construction.

There are other forms of wall construction from which choice can be made, such as reinforced concrete, concrete plaster on wire lathe, concrete blocks, terra cotta hollow blocks with or without steel reinforcing strips, brick, corrugated iron, and wood. The last two are rarely used at present, wood

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being objectionable on account of the fire risk, and corrugated iron in view of its short life. Of the other materials the question of relative cost is a large factor, and a suitable selection must be made to fit the case in hand.

I have always presented plans of all my buildings to the reinforced concrete contractors, that they might compete with the other forms of construction, but I have not yet been able to secure a bid or to have a building built as cheaply by them as from other materials, and when I say this I accord due appreciation to the question of insurance, as locality and contents are considered by the underwriters as well as the type of the building.

I am somewhat opposed to reinforced concrete on account of its lack of what I term "manufacturing elasticity," since it does not adapt itself very well to alterations and extensions which are constantly being made in plants devoted to foundry work. Brick, concrete blocks, and hollow tile are the most adaptable, brick probably being more so than any of the others. Considering the present price of brick, no saving can be effected by the use of the other two forms of covering, although in the large foundries to which I refer, the weight of the steel can be maintained at the minimum by the use of hollow tile above the windows.

For interior partitions hollow tile makes a firm, cheap wall. Concrete plaster on wire lathe, expanded metal, or galvanized netting usually requires so much supporting steel that it is quite expensive and practically costs more than brick and does not possess the advantages of the latter.

Steel roof trusses should be carefully designed so that they may be conveniently reached with cleaning and paint brushes, especially in foundries of the continuous type, where considerable vapor arises from the cooling sand. The trusses and columns should be carefully and thoroughly painted. Roofs are cheaply constructed of wood, with slag or gravel covering. This covering is favored in view of its low first cost, as against slate, tile and special forms of reinforced concrete. I have had only one disastrous experience with a roof of this kind and that was due to the fact that the sprinkler system had not yet been connected.

Windows except where there is an exposure, are generally made with wooden frames, glazed with factory ribbed glass and should be fitted to tilt, thereby securing the greatest possible opening. There was at one time a craze for making walls almost entirely of glass and steel. These buildings, however, are difficult to heat in winter and to ventilate in summer, while the glare of the direct sunlight is most unpleasant. Many plants of this kind have adjusted curtains to the windows and have glazed portions of the windows and in some cases large sections have been removed.

A building wall containing 50 per cent of window space will usually be very completely lighted for any width of structure and in any event passages and storage departments can be placed in the darker sections.

I am an advocate of metallic bars and ribbed glass for skylights, and in continuous foundries where a large amount of vapor is present a copper bar is cheapest in the end.

All of the floors I have described have been used successfully, but there is one type that I have not referred to and which is built of ordinary brick, with rails laid thereon, over which the flasks of the machines can be moved as the case may require. The rails should be laid down on sleepers in a sub-base of concrete, if this floor is on the ground level. The floors of the charging departments should be made of steel plates without tracks or in fact any ridges of any kind to interfere with the free movement of trucks and the use of shovels or forks. The cupolas should be set fairly high so that a man may work conveniently under them and to facilitate also the handling of ladles of various sizes. This is especially a desirable feature for continuous foundries where a ladle reservoir is provided with a skimming device which is located between the cupola and the pouring ladle.

The charging door I usually make very large, with a heavy cast iron curb, that a truck of scrap or coke may be run right

up to it and dumped in. The opening is best protected by a wire screen raised and lowered by counterweights. The installation of spark deflectors depends somewhat on the location.

I sincerely hope that some one will soon devise a practical cupola blast regulator. I have some ideas on the subject myself, but have been too busy to develop them.

Depending on the work, I advise from 11 to 14 feet above the tuyeres as the proper height of the opening in the cupola for economical and rapid melting. After considerable experience with tuyeres of various types, I still adhere to the old-fashioned square box tuyere as being the most reliable and efficient. Blowers vary in accordance with the service they are to render, my preference being for a positive blast blower for cupola work, with independent engine or motor, as circumstances may dictate. The motor should be provided with a speed regulator to control the melting, the latter being imperative for continuous practice. For air furnaces the centrifugal blower seems to be best adapted, a simple unloading device being sufficient for its regulation. It is, of course, needless to say that the larger the fan within reasonable limits, the smaller the consumption of power.

I also advocate the slagging of the iron as the melting proceeds, and the tonnage of the heats will naturally indicate whether or not a special conveying apparatus should be used for handling this slag. A wheelbarrow is, of course, the simplest device.

Raw Materials.

The coke should be kept under cover and handled as little as possible. Scrap should be handled according to its nature, as no single method will answer for all grades, although the magnet seems to be more adaptable than any other method. A system of handling pig iron will depend upon the amount consumed. Small quantities for small cupolas which must be broken can be handled more cheaply by common labor, while large tonnages offer a prolific field for the use of a magnet and adds considerably to the storage space. I have yet to be convinced of the value of a cupola charging machine. Storage yards for charging materials should be served by an overhead crane and industrial tracks should be used as little as possible.

Plunger elevators are best adapted for charging floor service. Whether the machine should operate directly by hydraulic pressure or with some elastic medium interposed between the water and the source of power will depend largely upon conditions. In large foundries and especially for continuous work, I usually provide a speaking tube between the melter and the charging floor that the chargers may supply coke in accordance with the demand for iron from the floor. From this you can see that the melting ratio is of comparatively little importance in this work, when compared with the cost of a completed mold. Frequently the core alone costs several times more than the coke employed in melting the iron.

Cranes.

For handling large flasks I prefer a locomotive crane, as it gives the greatest flexibility with the least expense. The practice of running an overhead crane through an opening in the end of the building is very expensive and unsatisfactory, requiring as it does expensive building construction. It is furthermore impossible to keep tight against the weather while the flask yard is limited to the space directly in line with the crane runway and generally in line with and obstructing the growth of the foundry. By the use of the locomotive crane a site of any shape can be utilized and the crane can enter the foundry at almost any point. As it is operated by steam, it can be driven independently of the plant. For indoor flask storage, trucks and elevators provide suitable and convenient means for handling.

Belts of a liberal size with bucket elevators are best adapted for handling sand when it is to be delivered to the various parts of the foundry mechanically. Belts may safely be used for receiving hot sand dumped out of flasks, though containing many sprues, much shot and chaplets. Belts also may be used for handling flasks in continuous work even though they are hot and of considerable weight. I also advocate

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sand riddles with bronze wire, as it lasts longer than iron, steel or brass. Wood or reinforced concrete is the best material for sand hoppers, conveyor troughs, etc., while all the advantages are in favor of wood.

Continuous Systems.

In designing continuous systems, whether wholly or partly automatic, care should be taken to keep the various operations independent of each other that any interruption to any one may not affect the others. The efficiency of this method of producing castings depends largely on the care given to this feature. I have known of some who have failed entirely as a result of the too close adjustment of the various operations, whereas a little room between them would have made the plant a success.

Core rooms naturally depend on the nature of the work. For large and intricate work they should be located in the foundry, while others can be placed in separate buildings and can deliver the cores to the foundry on conveyors and can later be distributed by boys. For making cores of moderate size to be handled in dryers, I advocate that the benches should be so spaced that the oven cars can operate between them, permitting the finished cores to be placed directly on the cars and when filled they can be run directly to the ovens over suitable tracks. After the cores are baked the cars can be delivered to the core storage room, thus obviating unnecessary handling.

For cores of large or moderate size I prefer an oven which has a long arch at the bottom with fire and combustion chambers underneath and the heat thus radiated will circulate through every part of the chamber. For small cores I had devised an oven heated by oil or gas containing a conveyor. Learning later that the same could not be patented owing to a previous right on a continuous baking machine, I lost interest in the same. A plant which I built has eight of these in operation, using oil in conjunction with waste heat from the malleable annealing ovens.

When cranes and tracks are used, care should be taken to prevent points of congestion at meeting or transfer places.

SOUND CASTINGS

By David Spence, Franklin, Mass.

There is at present a great demand for castings for printing machinery and tools, and being actively engaged in that line, I have made an effort to develop details in practice which have given most excellent results. Thus the matter of a little gate enables me to get out castings of printers' rolls, clean and sound, with no loss, while formerly the percentage was very high.

When I first worked in the foundry, the method in vogue provided for the use of a storage catcher on the mold, and to run castings with a small gate using a large basin to hold the iron. This was very good. Later came the needle sprue system which was a step far in advance of the old way of bringing the work sound and clean.

Now that we have a variety of patent gates, each good in its way, we can get printers' rolls and gear blanks as sound and clean in green sand as if made in loam or dry sand.

While in Chicago, I called on a firm using many gear blanks and was asked to guarantee the defective work down to 5 per cent. I did it, and out of an order of 300 gear blanks of various dimensions, less than 5 per cent were defective. These were all made by running them on the hub, with four small spindle gates and a large basin running across the flask. The iron used was hot and fluid. I always advise the use of iron not too hot nor too dull, but preferably the hot. The molder has his part to play also to get good sound

castings. That part is to make a good clean mold, well vented, so that the removal of the gases may be readily accomplished. The molding sand should be good and open with not too much loam in it.

For facing for printers' and laundry rolls I use five parts molding sand, one part fire sand, and one part of sea coal with a little flour. This all mixed together and dampened with stale beer or molasses water and gives fine results.

The iron used should be low in sulphur, close grained, and a small percentage of car wheel scrap should be added, as well as high silicon iron to insure the proper softness. The middle of the heat is where I prefer to take the iron for this special work.

For the last 25 years I have given considerable thought to the subject of mixing iron for foundry work, and must say that at our conventions I have always found some valuable points along these lines. We are doing much in this quiet way for the thinking man of the foundry, and I need not tell you that we need thinking men in this industry, as well as in any other branch of manufacture.

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PRESIDENT'S ADDRESS

By W. H. McFadden

Gentlemen—I count it an honor to be able to preside at this, the twelfth convention of the American Foundrymen's Association. The eleven years of life of this association coincide with eleven years of progress in the American foundry industry. I cannot properly eulogize this organization for the part it has taken in the wonderful advancement in this important branch of the iron trade. I can say no more than that progress in the American foundry began with the birth of the A. F. A. and that the development of "Ye ancient" to our modern foundry has been largely due to the enlightening influences of this association. We have but to think of one of the many lines in which the foundry has advanced; then go back in the proceedings of our association and find that it began with a question or a suggestion of some member at one of our meetings; it was later made the subject of a paper and discussion; then offered to a committee for study and report; and finally given to the foundry industry in our journal.

Foundry Metallurgy.

For example, foundry metallurgy was among the earliest subjects brought before our association for discussion, and our proceedings contain papers which have proved of inestimable value to foundrymen in the development of this branch of foundry practice.

The foundrymen began with experiments on the effects of silicon on iron, its influences were studied and the results were explained at our meetings. Differences of opinion were frequently manifested, but the knowledge gained proved of great benefit to foundrymen. Experiments and discussions soon brought out the fact that silicon was but one of several elements which exerted a marked influence on cast iron. This led to a study of the effects of other impurities, and has resulted in the development of foundry metallurgy into an exact science.

There is no longer any excuse for the uncertain hit or miss methods formerly used for in mixing foundry iron. Our proceedings contain material, which, if intelligently applied, should allow the foundryman to shake off the shackles which bind him to the ruts followed by his forefathers.

It is a surprise to me that the opportunities offered by metallurgy are not more universally taken advantage of, as the foundry metallurgist has explained many of the problems formerly thought unsolvable. Where metallurgy is not a success in a foundry, it is due to the lack of knowledge of the one who seeks to apply it rather than to any defect in our present knowledge of the science itself.

Standardized Drillings.

In order to aid the foundry chemist to obtain uniform results, this association developed a series of standardized drillings of cast iron which have become the arbitrator in nearly every laboratory in America. While these drillings are now under the Bureau of Tests of the United States government, their inception and preparation resounds greatly to the credit of our association.

Standard Methods for Analysis.

Hand in hand with the work of standardized drillings has gone the work of standard methods for analysis of iron. Started some years ago, the work has since been in the hands of our metallurgists. After four years of hard and painstaking labor, their committee has at last succeeded in placing before our association a series of standard methods. Their adoption, for use in cases of dispute, will greatly aid in preventing dissension between the buyers and sellers of pig iron. The secretary and committee have worked arduously for the association and deserve great credit for their results.

Standard Methods for Testing Cast Iron.

The work of this association formed the basis for the standard methods for testing cast iron adopted by the American Society for Testing Materials. The data published in connection with this

work, in our proceedings, is of itself an encyclopedia on cast iron, giving, as it does, the analysis as well as the strength of a large number of characteristic irons. It is to be regretted that these specifications have not met with more universal usage; it is possible that they do not fulfill the requirements of founders and, if this is so, steps should be taken to remedy the defects. Cast iron will maintain its position in the future solely by the intelligent application of some method of testing, which will give the engineer an accurate knowledge of its strength in the casting as it makes up a component part of the machine.

Standard Methods of Buying Pig Iron.

The work of the association in bringing about the adoption of standard specifications for buying pig iron deserves mention. The old method of buying by fracture is rapidly disappearing and the modern method of buying by analysis is rapidly taking its place, much to the advantage of both the buyer and the seller. This happy condition of affairs is largely due to the work of this association and the publicity given the matter by its proceedings.

Standard Methods of Foundry Cost Keeping.

We have before us another matter which deserves the careful attention of every foundryman, viz., methods for keeping foundry costs. All foundries have some method, however crude, for ascertaining costs of castings. A careful study of these methods reveal the fact that many of them are not only incomplete, but very misleading. The association should assist in the development of some simple system which will give accurate costs. This should be a foundation, as it were, on which those foundries desiring to go into detail could build and still preserve the principles of the standard method.

Some system is essential to remedy the uneconomical working conditions which exist in our jobbing foundries. Some method should be adopted for properly distributing the general expense or burden of a plant so as to enable the foundryman to ascertain just what class of work was profitable for him to make and what should be left for some other to handle. An intelligent system would lead to a rearrangement in bidding on work which would cause a much improved condition in our jobbing foundries.

Affiliated Associations.

This address would not be complete without a reference to our Associated Foundry Foremen. Its growth has rivaled our own association, and the results of its formation are very apparent in a desire on the part of the foremen to improve their knowledge of foundry matters. I have read, with much interest, the accounts of the meetings of the different sections, and of the topics which they have for discussion. Such an interchange of ideas along educational lines is a healthy evidence of an advanced state in our foundries. This association is aiding its members to improve foundry conditions by intelligent consideration of those subjects which are of paramount interest to our foundries.

Supply Association.

It is my pleasure to welcome to our midst the new affiliation of our foundry supply fraternity—"we always have them with us"—but this year it is in a brand new guise. Individually, they have been hard to resist, collectively, it behooves the foundrymen to beware. Seriously, the closer association of the foundrymen with those who supply us with materials cannot fail to work for the benefit of both. Too much credit cannot be given to those who have met every demand of advanced conditions in the foundry with improved materials. The exhibition of foundry devices at our convention will prove of value, not only to the seller, but to the buyer. The latter is better able to judge the value of a machine for his own work by watching it operate, than by seeing it in print or in the eye of the sales agent.

This is especially true in regard to the molding machine. Your president would venture the prediction that this most valuable adjunct to our foundry is in its infancy. Conditions are forcing the founder to adopt them whether he will or not, and the exhibition of the most modern types at our conventions,

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where they may be discussed by foundrymen, will do a great deal towards advancing their use.

Brass Foundrymen.

We are welcoming the brass foundrymen of the country to our meetings this year, affording them the benefit of our experience, and aiding them to form a brass foundrymen's association. It gives me great pleasure to welcome them to our meetings, and I trust that Philadelphia will prove as good a father to their association as it has to the American Foundrymen's Association.

Foundry Education.

Education is the keynote of our organization; there is a decided interest prevalent at the present time in foundry education. Our organization should therefore be in the forefront of this movement. Many papers upon educational subjects have from time to time been read before this association and different projects have been discussed for establishing foundry schools.

The association has a committee on technical schools which has acted in conjunction with a Pittsburg Foundrymen's Association committee in regard to a foundry course at the Carnegie Technical Schools in Pittsburg.

Five instruction papers have been published by the A. F. A., and more are in process of completion. These papers are elementary and are intended to give general instruction in different branches of foundry practice.

Aside from the above, this association, by its papers, discussions, committees and exhibits acts as a general educator to the American foundry.

It would, however, seem advisable that this association take a more active part in shaping the educational sentiment so active at present. The question is complex, and it is not my intention to discuss it to any extent in this address. I shall rather point out what has been frequently overlooked, viz., that no one course would cover all the ground referred to by those discussing this question. The classes to be educated are technical men for superintendents, engineers, metallurgists and chemists, and industrial men for foremen, molders, apprentices and handymen.

Three different schools, or courses, would be necessary to advantageously benefit all of these conditions. Our technical schools should so equip themselves as to properly teach the first class mentioned. It is obvious that they are not at present fitted to do so. It is the duty of the members of this association, both as an association and as individuals, to exert their influence in such a manner that technical schools will give more intelligent attention to this important branch of industry. In order to accomplish anything of value, the technical institutes should be urged to provide instruction by scientifically educated men who have had practical foundry experience. Courses and equipment should be supplied to give a practical as well as a theoretical foundry training; such instruction should develop men who, in a short time, would be able to work into foundry superintendents and engineers.

The education of foremen, molders and apprentices presents a different problem. In localities where trade schools with night courses exist the problem is simplified. The value to the student then depends entirely upon the instruction given. The trade school should teach such branches as would aid the foreman to become more proficient, the molder to be a better molder and fit to assume the position of a foreman and the apprentice to master his trade. Localities favored with trade schools where foundry practice and allied subjects were intelligently taught, would soon become the supply depot of foremen and superintendents for the country.

The third school should educate handymen and make them proficient with their hands and brains, thus enabling those who have been unable to learn a trade to improve their condition. Such schools are, however, being maintained by other organizations and do not come entirely under the scope of this association. The subject is, however, a vital one to foundrymen and the scarcity of competent molders together with the disposition in some quarters to restrict the number of apprentices make it one which may well be borne in mind.

Fluxes and Alloys.

A paper recently read before the Pittsburg branch of our association called attention to fluxes and alloys in a very interesting manner. Our foundries are, from time to time, flooded with all kinds of quacks for the improvement of cast iron. It is not possible for the foundryman to separate the "chaff from the wheat," and consequently all are generally classed as "bad" for lack of proper facilities for determining their efficiency. It would seem to be within the province of this association to have these materials investigated for the benefit of our members.

Permanent A. F. A. Testing Department.

Our association needs a permanent department for investigating the problems which are continually arising in connection with our industry. If this department could be installed in connection with one of our technical schools, it would be of great value to our association. Unsolved problems in regard to iron could be investigated in an impartial manner. Sands, fluxes, alloys, core compounds and blackings could be studied and tested much to the benefit of the manufacturer and the consumer. Our foundrymen, from an economic standpoint, could well afford to maintain such a department, for it would soon be shown that many of the materials used in our foundry are carrying much more than a legitimate profit. Such a bureau would, of necessity, require the financial support of this association. It is obvious that our present dues and financial conditions would not warrant such an undertaking.

The American Foundrymen's Association.

The American Foundrymen's Association stands for progress along educational lines. Under the guidance of our worthy secretary it has achieved a reputation in America, in England, and on the continents as a strong and progressive organization. We, as members, certainly owe it to the association to maintain this position.

Soon after becoming president, I ascertained the fact that the work of the association was hampered by lack of funds. The income was entirely dependent upon the dues of the members; an increased membership meant an increased constant revenue. I have consequently devoted my term to securing new members for the association and about one hundred and fifty have joined this year. This does not, however, make the income of the association sufficient to increase the scope of its work.

At the New York meeting the dues were reduced from $10.00 to $5.00 per year, with the idea that the membership would be more than proportionally increased. This was not the case, however, and, after consulting with many members, your retiring president advises that the dues be again increased to $10.00 so that the association may accumulate a fund which will make possible a permanent testing bureau.

Journal of the A. F. A.

In answer to some two thousand letters sent out this year in the interest of our association, I have had many inquiries as to our journal which has been formerly published in various forms. A journal would be of great benefit to the members of the American Foundrymen's Association, but to publish one with our present income would be out of the question. If the dues were changed back to $10.00 with our increased membership, we should have no trouble in issuing a journal which would prove of great value. It is very easy to assent to the request of your president, vote for a journal, and then go home and think no more about it until next year. Our secretary would need the support of every member were he again to publish a regular organ. The entire life of this association should not be bound up in one annual meeting. The members should be kept in touch with one another by a progressive journal. There is more interest in our work than ever before and the time is ripe for a movement which will bring a majority of the foundrymen of the country into the ranks of this association. This can only be accomplished by the united efforts of all our members.

In closing, I desire to publicly express my thanks to our honored secretary, Dr.

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Moldenke, for his proficient and untiring efforts in behalf of this organization and for his unfailing courteous assistance to me during my term as president.

I wish to thank many of you for kind words of encouragement and to urge you to be loyal to your next president in deeds as well as words. Should he ask you to obtain one new member do not again ignore the association which has done so much for your chosen industry.

My congratulations to the Philadelphia foundrymen, to the Foundry Supply Association, and to our secretary, for the able way in which they have handled the arrangements for this twelfth gathering.

I wish personally to express the obligation of this association to those who have so faithfully labored in the production of papers for these meetings.

Our conventions happily combine three important phases of foundry work —the educational, as illustrated in our papers; the mechanical, as demonstrated by our exhibits; and the social, as dispensed by our hosts. Let us, for a few days, forget the cares of the foundry and freely partake of the educational and social feast which is so abundantly set before us.

Fellow members, prosperity has brought increased responsibilities in the form of vexing problems which are before many of us for settlement. Your retiring president wishes you all a continuation of this prosperity, and he looks forward to a future in which the enlightening influences of this association shall have permeated the foundry industry and so broadened the employer and the employe that they may meet without strife on the common ground of mutual helpfulness.

THE MALLEABLE FOUNDRY AS A BUSINESS VENTURE

By Dr. Richard Moldenke, Watchung, N. J.

Hardly a week passes but that I receive inquiries regarding the cost of establishing malleable castings plants. The answer I have to write invariably is: "Unless you have at least five tons daily to make—don't."

When one has personally gone through the building of a great establishment, and has the making of hundreds of thousands of tons of malleable castings behind him, caution is the order of the day, and unless the quantity is sufficient and the deliveries from outside unsatisfactory, it is wisest to buy from existing plants rather than to venture upon the little known fields of the heat treatment of white cast iron, for that is what the malleable casting industry comes to in the final analysis.

As a rule the requests for information come from those iron foundries which get orders for plenty of gray iron castings with a sprinkling of malleable, and possibly some steel castings also. The high price they have to pay outside for small lots naturally interferes with their legitimate profit, and hence the desire to produce for themselves. I believe that when the electric furnace is perfected, or made commercially possible, that a different aspect will be given to the case, but at present we have to take things as they are.

The question of embarking into the malleable casting business resolves itself into a market for the work to be produced, and the location to make that work at the lowest cost. It is very rare that a location is picked out unless the territory tributary to it can support a comfortably live malleable plant.

Those concerns which use a large quantity of these castings are the natural pioneers for a given region. The fact that they can make money where they are would be a pretty good guar-

antee that they can either save money or get their desired deliveries by going into the malleable casting business. Moreover, their profit as manufacturers will carry them over the two or more years of loss in starting the malleable plant.

Advantages and Disadvantages.

To sum up briefly the advantages and disadvantages, I give the following:

(1)—The expanding market for malleable castings, and the great room for improvement in most of the producing works, gives a living chance to the man to go in the business, provided he understands it thoroughly.

(2)—In times of prosperity, plants in existence, where great caution is exercised, must turn away large quantities of offered work, being unable to produce it.

(3)—The moment the malleable castings works are full, deliveries are so desperately bad and slow that attention is turned directly to new enterprises coming in.

(4)—The adaptability of the malleable casting to specialties in railroad, agricultural and hardware lines, is such that the beginner has a good chance to succeed provided his specialty is good.

(5)—Where absolutely good material is required, it pays the consumer of malleable castings to go into making these himself, provided he has enough tonnage. Only he who knows how easily one can slip up on the quality of the malleable casting, also knows how often this is done, and the customer is not the wiser.

(6)—The malleable product from its adaptability to specialties, and comparatively light castings at that, means a production in quantity of each separate piece. Hence it is not a question of half a dozen castings, but oftentimes several hundred thousand, or in other words continuous production, with comparatively well regulated and systematized shop cost.

Now the disadvantages follow from the above:

(1)—The expanding market while making room, also leaves very empty shops in dull times, for the existing plants usually expand with each high wave of prosperity and manage to hold the desirable customers.

(2)—Where the work turned away by the full plants is taken by the beginner, it is at either lower prices, or if at high prices, is lost again when these fall. The ability of the founder who commences, to hold customers who may have been exasperated elsewhere, or his ability to produce cheap enough to cut under, or most likely his having a specialty which pays the freight, will make or break him.

(3)—The high capital required is a great detriment, being about four times as much as for the same tonnage in gray iron for the works alone. This means more than appears on the surface. The malleable casting process is intricate, the chances of loss great, and it takes fully two years to get a desirable class of men in the shop, after all the bums of the country have passed through it. Hence the chances of no profit, if not worse, for a long time, which must be met and carried until success appears. To give an instance, a rough calculation of the cost of a shop to produce 50 tons of castings daily would come up to say $250,000. By the time that shop would be actually producing the 50 tons daily at a normal shop cost, over double the amount of money will have been expended. Then, however, with a good market, the shop will pay handsomely.

(4)—The high grade of skill required. While the process as we now know it is comparatively simple, we have to reckon with so many factors that an expert in malleable castings is a scarce article. With the range of composition for the iron for various thicknesses of the castings very close, a white iron to start with, with its double contraction, and danger of shrinkage in the interior, with the necessity of chills, the limit to the size and weight, the expansion in the anneal, etc., it is a pretty delicate task to turn out large quantities of various classes of castings, and have them all high grade. Hence the high salaries the important men must be paid, and the eternal vigilance required in the works. It must be remembered that your day's work goes into the anneal, and you do not see it for a week. The next

day's work the same, and hence a mistake in the temperature of the ovens, and you have ruin for possibly a week before you find it out. I remember the slipping off of the night annealer to a nearby speak-easy, with the increase in the natural gas pressure just at that time, which meant thousands of dollars of damage for two or three hours' inattention.

(5)—The fierce competition that is met with. This is queer but nevertheless the case. In spite of all the troubles the malleable casting man has to contend with, he makes himself more by cutting his competitors' prices, until all have very little left. This is primarily the case, because to run a shop successfully and to hold an expensive organization, everybody must be busy. The first aim therefore is tonnage, to keep the shop producing at maximum capacity all the time, practically regardless of prices sometimes. Hard times drop prices in the malleable shop far quicker than in the gray iron establishment. I remember the time when castings were sold to the railroads at a shade less than two cents a pound, delivered. When it is remembered that malleable castings ought to bring a cent a pound more than the corresponding gray iron work, it will be seen what a new man is up against in starting when prosperity is on the wane.

The further reason for this fierce competition is that nearly everybody in this line has a specialty or several of them, which sell under patents and for as high a price as the community will stand. Hence this velvet can cover a deficit to keep the rest of the works in operation. This, of course, is hard on the man who has no specialty, and hence again, the necessity of having abundant capital until such a specialty is found.

To sum up then; with a good specialty or a number of castings used in the manufacture of well paid for articles, and a sufficient daily tonnage, it is good policy to go into the malleable casting industry as a business venture; but with less than say five tons daily safe, and with insufficient working capital, and men not thoroughly trained in this line, it is better to let it alone.

FOUNDRY DESIGN

By F. A. Coleman, Cleveland

A foundry is a machine composed of a number of parts, each part having a certain duty which should be performed in harmony with the other parts. This machine should be housed in buildings erected to suit the machine.

Raw materials are received or fed into the machine at certain places and the output is finished castings. We think this statement covers the foundry proposition; if it does, we are led to believe there are some peculiar methods employed by many foundrymen.

A foundryman desiring to buy an engine does not go to the engine builder and ask for an engine large enough to fill a building 30 x 40 feet, but he tells him he wants a certain power and type of machine. Nevertheless many foundries start with the size of the building and work backwards to the machine they desire to house. It is this illogical method of building foundries that has tempted the writer to prepare this paper on "Foundry Design," not with the idea of trying to write a treatise on foundry buildings, but of trying to help in the design of the foundry machine.

Many statements made herein will undoubtedly be questioned by foundrymen because they will not line up in all cases with certain exact and known conditions, but general conditions are being discussed and necessarily general statements must be made; therefore the attempt will be made to treat the subject in a very broad manner.

One expecting to enter the foundry

business may have a certain fixed sum of money to invest and desires to produce the best results from this investment; or a certain limited piece of property is to be used and it is necessary to produce the greatest output from the area; or it is desired to produce a certain tonnage of castings. Ordinarily, any one of the above three conditions will explain the beginning of a new foundry, and a careful study will show that in no one of them should the building be allowed to become the determining factor in the design of the machine.

The writer claims that the buildings are drawbacks to the foundry; they keep out light, complicate the ventilation, and are in the way generally.

Problems of Foundry Design.

It seems as if there are but three problems to be solved in designing a foundry, which may be stated as follows:

I. Given a certain sum of money, to produce the largest and most efficient foundry, or

II. Given a certain area of land, to produce the greatest output efficiently at the least expense.

III. Given a certain desired output, to produce the highest efficiency at the least expense.

The general problem is to produce the greatest result with the smallest expense. This of course is what all foundrymen are seeking to do.

There are many kinds of foundries, and while it is not really necessary in discussing this subject to name them, yet it may be of interest to see how many different lines of foundry work are carried on.

A classification according to metals follows:

I. Iron.
II. Steel.
III. Brass.
IV. Aluminum.

I. Iron foundries produce gray and malleable iron castings.

II. Steel foundries produce acid, basic and crucible steel.

III. Brass foundries produce all kinds of alloy castings, of which we may assume copper as the base.

IV. Aluminum foundries are almost universally a part of brass foundries and produce alloys containing high percentages of aluminum.

Classifying according to methods of melting and avoiding the unusual or experimental methods we have:

I—IRON—
- Cupola furnaces.
- Air furnaces.

II—STEEL—
- Open-hearth.
- Converter.
- Crucible.

III—BRASS—
- Crucible.
- Direct melting.

IV—ALUMINUM—
- Crucibles.
- Direct melting.

Classifying as to fuels we have:

I—IRON—In the cupola furnace—
- Coke.
- Coal.
- Charcoal.

In the air furnace—
- Coal.
- Gas.

II—STEEL—In the open-hearth—
- Gas.
- Oil.

Iron melted in the cupola for the converter, with cold blast.

In the crucible furnace—
- Soft coal.
- Oil.
- Gas.

III—BRASS—In the crucible furnace.
- Coke.
- Hard coal.
- Soft coal.
- Oil.
- Gas.

In direct melting furnace—
- Oil.
- Gas.

IV—ALUMINUM—In the crucible furnace—
- Oil.
- Gas.
- Coke.

Direct melting—
- Coal.
- Oil.
- Gas.

Classifying according to character of work:

I—IRON—
- Jobbing—light work.
- Jobbing—heavy work.
- Architectural.
- Hardware.
- Stove plate.
- Soil pipe.
- Water and gas pipe.
- Car wheel.
- Pipe fittings.
- Machinery.
- Electrical.

II—STEEL—
- Jobbing.
- Electrical.
- Machinery.
- Marine.
- Railroad.

III—BRASS—
- Jobbing.
- Ornamental and art.
- Lighting fixtures.
- Architectural.
- Hardware.
- Plumbers and sanitary supplies.
- Steam and hydraulic.
- Marine.
- Bell.
- Automobile.

IV—ALUMINUM—
- Jobbing.
- Automobile.

These classifications are not supposed to be complete or exact, but on examining them it will be readily seen that many of these points enter into the foundry design. The foundryman should therefore settle a number of them before considering going ahead with a foundry proposition.

Classification of Work.

The foundryman should determine as closely as possible the class of work he expects to make and the process he expects to use in making it; if the class of work to be made is definitely known, the problem is simplified; too much importance cannot be laid upon this fact because the foundry can then be designed to meet known conditions.

It makes no difference what a foundry may make, all foundries have three general operations which are:

A—Melting
B—Molding
C—Cleaning.

A.—All materials, processes, equipment and labor, necessary to produce molten metal in the molds are included under this head.

B.—All materials, processes, equipment and labor necessary to produce a form of mold for receiving the melted metal come under this head; as cores are a part of the mold, core making is included.

C.—All materials, processes, equipment and labor necessary to remove adhering molding metal and excess metal not a part of the actual pattern come under this head.

According to this arrangement the melting cost would be the cost of the metal in the mold; the molding cost would be the cost of the molds and cores ready for the metal; the cleaning cost would include the removal of the rough castings from the mold, making it like the actual pattern and delivering to the shipping room; a number of overhead expenses would, of course, be chargeable to these three operations.

Automobile and Marine Engine Cylinders.

We may assume the case of a foundryman who desires to make automobile and marine engine cylinders; he either knows from his experience or finds on investigation that he can produce the best castings with the air furnaces; this of course determines his method of melting.

He next finds that he can depend, or will have to depend, upon the business of certain customers, and that it will be to his advantage to make the work upon some style of molding machine.

If he builds his foundry upon this last assumption, and finds the business comes as he expected, then he will get a certain output; if he has been wrong in his assumption, and he has to resort to bench or floor molding, then his output per molder will be reduced.

The first assumption would require a certain melting capacity per molder, while the last would require a smaller melting capacity per molder.

There are of course many points involved in the output of a foundry, but it may be roughly stated that the output divided by the area will be constant for the same line of work.

There are exceptions to this statement, of course. In a brass shop making sanitary work in iron flasks, the molds if poured flat may be stacked three and four high; if poured on end they cannot be stacked and the output of a molder will require a much larger area.

The endeavor is being made to show that many things are peculiar to each metal and to each method, and therefore all these points should be taken up and settled as a part of the preliminary work. It is admitted, that at times no one can determine what should be done, but it is to the foundrymen's interest to reduce the elements of the unknown and the uncertain as much as they can.

Foundry Layout.

It can now be assumed that the foundryman has definitely decided to make

a certain line of work in a certain way, and is ready to design a foundry machine which will give him the greatest output of good castings for the least cost.

He should have a map of the property showing streets, alleys, railroads, etc., if the property is or may be effected by buildings adjoining, these should be noted.

If the area is large and the surface is irregular it may be necessary to make a typographical survey of the tract, but it can be set down as a fact that a careful study of the property itself will show that certain advantages may be gained by designing the foundry with reference to these property conditions.

A building 70 x 100 feet may be designed and do very well on a ten acre lot, but will be a failure on a lot, 70 x 100 feet, surrounded by high buildings in the city.

The amount of metal to be melted to produce the tonnage of finished castings, and the number of molders necessary to handle the metal are next determined.

From this we find the area required for the furnaces, molders, core makers, core ovens and cleaning; the areas and capacities of the storages for metals and fuels are found; the storage of the flasks, molding and core sands, etc., may be determined; furnaces, molders, core makers, and cleaners supplies should have a place and require areas which should be determined; pattern and machine shops; pattern storage, locker and wash room; closets and urinals; sand preparation rooms, shipping room, room for holding castings to see if orders are completed; foundry foreman's office; main office; power plant and laboratory; it may be necessary to consider all of these.

Certain operations requiring floor space are necessary to every foundry; some of the things noted are needed by some foundries, and all such areas should be determined as closely as possible.

The determination of the various areas required, and such other information as is peculiar to each foundry, places the foundryman in position to start the actual layout of the foundry.

Arrangement of Areas.

The problem now is to make an arrangement of these various areas which will permit of the movement of the materials through the various processes of melting, molding and cleaning, and deliver the finished castings to the shipping room with the smallest amount of labor, the minimum amount of equipment, and the lowest cost.

The storages for all materials received should be close to a central unloading point where they are to be used. The first statement is particularly true of foundries served by sidings.

Fuel and metal should be very accessible to the furnaces. Sands should be convenient to the core room and the molding floors. They may be passed through the sand preparation rooms and then be distributed to the core room and the various molding floors. Likewise the core ovens should be close to the fuel, and the core room located so as to serve the foundry without unnecessary handling of cores.

Core Departments.

In foundries served by cranes, the ovens should be arranged so that the cores may be handled from the cars by the main bay cranes into place.

This does not mean that the main cranes should be used to load cars, which may be done by core bay cranes. It is not profitable to bake large and small cores in the same oven; the best results are obtained, both in baking and in fuel saving, by baking bench cores in small ovens and floor cores in large ovens. If possible the small core racks should be placed on the division line between the core room and the foundry and accessible to both.

Charging Floors.

In the foundries where the charges are hoisted, the charging floor should be large enough to carry at least one day's supply to avoid shut downs. In heavy shops running two or more cupolas side by side, they should be spaced so that two cranes may serve at the same time; pits should not be located in front of the cupolas.

Provisions should be made for the handling of the ladles at the cupolas by

small cranes so as not to tie up the main bay cranes.

It is best to pull the heavy and mold core cars by haulages independent of the cranes; the heavy cranes should not be called upon to do all kinds of work, which can be better done by lighter and cheaper equipment.

All areas should be regular in form and not cut up, posts on columns should be avoided and should be kept off the molding floors or placed at division lines between bays or floors.

Taking up the form of construction best adapted to foundry purposes, it would seem that of two types, the one which will give the greatest amount of light and the best ventilation should be the one to adopt.

Crane loads and roof loads should be carried directly through columns to the foundations; there is no reason for requiring the actual walls to carry loads.

Light and Ventilation.

Every foundry requires all the light it can get and ideal results are obtained when there is nothing but glass from the sills to the eaves and a continuous line of glass from end to end.

The lanterns or monitors should be wide and high; a narrow monitor is about as expensive as a wide one and not as effective.

The general form of construction as above recommended is so simple and good that it does not seem necessary to mention it, and yet the majority of foundries are much more costly and do not produce as good results.

In addition, whitewash or cold water white paint are worth many times the cost.

If the foundries will wash the windows but once a year they should do it in October and not in the spring; many a foundry can declare a dividend with the money wasted on lighting, when nature stands ready to do it for nothing, if only given the chance.

Do not, under any consideration, build any kind of a foundry to do any kind of work with less than 14 feet outside walls, a single bay foundry 50 feet wide should be not less than 16 feet high on the sides.

When floors are to be paved in the foundries, good concrete will give first-class results. The writer is fully aware that the above two statements will be very severely criticised.

Power.

Foundry power is a question which interests many. Shops requiring a small amount of power in the cities can often buy power from the electric companies to good advantage; this is particularly true when there is a large fluctuation in the quantity used.

The number of producer gas engines will increase in the foundries as there are many points in their favor; probably the majority of foundries use less than 100 horsepower. The building of successful bituminous coal gas producers in units as small as 125 horsepower, together with the present reliability of gas engines, are strong factors in making this increase.

Lockers and Wash Rooms.

The modern foundries consider locker and wash rooms as necessary; they should be used for washing and dressing rooms only, and should be in charge of some one at the time the men are going to and leaving work.

The closets and urinals should be located so that it is not necessary for the men to leave their floors; the saving in lost or loafing time is worth the additional cost.

In the larger plants a room for the holding of patterns on their way to the foundry is a convenience. Patterns are thoroughly overhauled to know that they are in condition, with all parts, core boxes, etc., accounted for.

Cleaning Department.

In foundries running a large number of pieces of the same pattern, a casting cleaning room has many points in its favor; castings are turned into this room from the foundry; they are counted and inspected and any shortage must be supplied by the foundry; this avoids congesting the shipping room with incomplete orders. In shops having factories, this room really becomes a store house where requisitions from the factory are filled.

The foundry foreman's office should be located convenient to the foundry to give a good view of the plant; in larger shops requiring a number of sub-foremen, this is not so important.

Distribution of Power.

The distribution of power throughout the plant by motors does away with the necessity of making the location of the power plant a factor in the design of the foundry. The pattern shops, flask makers' shop and machine shop are not an actual part of the foundry, and while it may be necessary to consider them, nevertheless, the foundry layout should not take these into serious consideration.

The actual foundry provides for melting, molding and cleaning; everything else which may be necessary is subsidiary and should give way.

The writer desires, however, to qualify the above statements with reference to foundry plants whic' are designed to occupy the entire area of the property, and where the greatest output must be secured from this area. Under such conditions everything must be considered as a part of the whole and it becomes somewhat a case of give and take between the various departments.

The east with its older foundries and closely settled localities has been, in many lines of work, forced or led into the construction of foundry plants of two or more stories.

The west is beginning to do the same thing under the same stress of conditions; the melting, molding and generally the core making are carried on on the top floor; cleaning, sorting and shipping and other operations being done on the lower floors; such foundries are generally engaged in light work only.

Building Materials.

Of the materials of construction it may be said that brick is mostly used with wood or steel framing. Fire proof construction is increasing; the foundry with its furnaces, ovens, hot metal and careless class of employes is peculiarly subject to fires; that this fact is recognized by nearly all foundries is shown by the construction of the fire proof pattern storages.

Oftentimes the destruction of the plant itself during the rush season is fully as serious as the loss of the patterns; this is true of jobbing foundries where customers generally insist upon the delivery of their castings, fire or no fire.

In small or light shops, floors should be planned to give each molder a certain area which can be served very readily with metal either by trolley system or some other method which will take the metal quickly and without confusion to each area.

The great need for designing plants not only for the present but for the future is shown by the large number of foundries, which have a main foundry and a vast litter of dog houses; many foundries are not thoroughly christened until they add such a dog house. But they are expensive; they break up the routine, require extra foremen and generally rob the main foundry of its share of light.

The writer believes that the foundryman should thoroughly study his plans on paper; each problem has an answer which can be more cheaply worked out on paper than on the ground.

It should be remembered that profit is the ultimate end; profit produced by making good castings at a low cost.

The fixed charges should be kept down. Bad design resulting in the expensive handling of materials means useless fixed charges, limited output and of course too high a cost.

Many an expensive investment in equipment or makeshifts could have been avoided in many foundries by the proper designing of the original plant. Many foundrymen now keenly realize that what appeared like a saving in construction has resulted in a heavy cost for operation.

NICKEL IN CAST IRON

By Jas. F. Webb, Elkhart, Ind.

In reporting on the tests authorized by this association last year, I beg to submit the following results: I made twenty test bars, ten with the nickel added and ten without, all from the same ladle holding 1,400 pounds, and of good hot iron. Nickel thermit was put into the bottom of the hand ladles, the aim being to get varying proportions of nickel into the metal and then to note results of the tests.

The determinations were made by H. E. Smith, of the Lake Shore railroad and are presented herewith:

Table I.
Physical Tests.
Cast Iron Test Pieces from Elkhart, Ind.

Mark.	Diameter, inches.	Cross Breaking weight.	Deflection.	Modulus of rupture.
1 N	1.25	3,000	0.11	46,870
1 N	1.24	2,970	0.09	47,520
2 N	1.24	2,510	0.08	40,160
2 N	1.26	2,820	0.10	43,010
3 N	1.26	3,000	0.10	45,760
3 N	1.25	2,690	0.09	42,020
4 N	1.26	3,130	0.09	47,710
4 N	1.23	3,010	0.09	49,330
5 N	1.25	2,370	0.08	37,030
5 N	1.23	2,570	0.09	42,130
1 X	1.26	2,990	0.08	45,600
1 X	1.26	2,790	0.09	42,550
2 X	1.26	2,740	0.10	41,790
2 X	1.25	2,890	0.10	45,140
3 X	1.26	2,750	0.08	41,950
3 X	1.23	2,690	0.10	44,100
4 X	1.25	2,610	0.09	40,780
4 X	1.23	2,770	0.10	45,410
5 X	1.25	2,470	0.09	38,600
5 X	1.25	2,760	0.09	43,130

Tests on 1¼-inch round bars, supports 12 inches apart.

Table II.
Chemical Analysis.

Mark.	Manganese.	Phosphorus.	Sulphur.	Silicon.	Nickel.
1 N	0.460	0.63	0.090	2.07	0.67
2 N	0.455	0.63	0.089	2.08	1.18
3 N	0.450	0.63	0.091	2.05	2.07
4 N	0.444	0.62	0.087	2.02	3.25
5 N	0.444	0.63	0.088	2.10	6.65
3 X	0.450	0.62	0.086	2.12	——

The results would not indicate a marked improvement in the physical strength of the castings, and would bear out the supposition that nickel in cast iron is either not distributed uniformly enough to do much good, or else will find its best use in special classes of the metal freer from the high percentages of impurities incident to the ordinary casting.

It is to be hoped that further experiments can be made to prove just what does happen when nickel is added to cast iron, and I take pleasure in giving the above results as a contribution to the literature of cast iron when nickel is added to the ordinary grade.

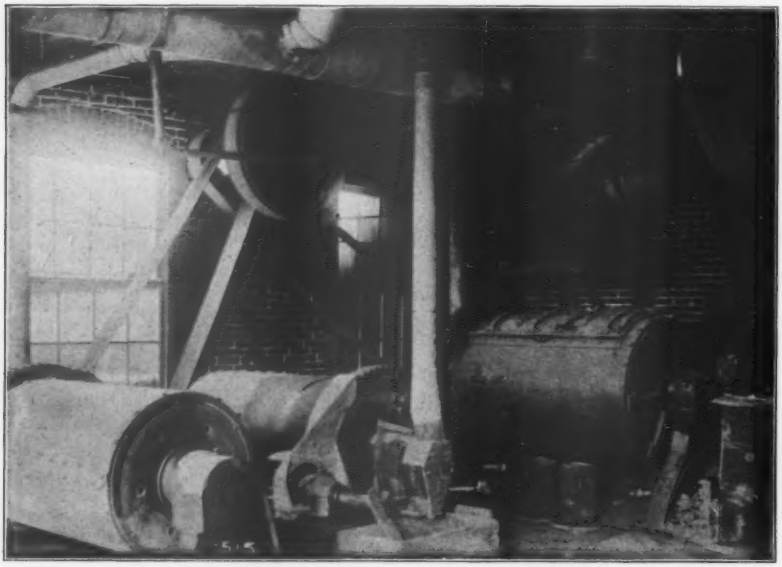
A PLEA FOR HEALTHFUL CONDITIONS IN THE BRASS FOUNDRY

By Walter B. Snow

In much of the early work done for the welfare of the employe there was a strange confusion of motives. Even though the project was primarily humanitarian in its spirit, the advertising department got in its work in proclaiming this spirit to all the world. But out of this confusion has now grown a definite recognition of the purely economic advantages of surrounding the workman with healthful conditions. While some other industries are more directly harmful to the health than is the brass industry, there is, nevertheless, ample opportunity within its field to greatly improve the conditions. Although the heat and fumes are primarily uncomfortable and only secondarily injurious, the greatest harm is done by the dust which is inhaled. This dust is usually of mineral or metalic origin resulting from the grinding, polishing, tumbling, and sand blasting processes, and also from the shaking out of the castings.

Injurious Industries.

It is commonly recognized that life is shortened by working in a dust-laden atmosphere, but the extent to which some industries are injurious is startling. In the cutlery and tool industry, which is declared to be one of the most dangerous of trades in this class, the average age of the operatives at death is exceedingly low and in establishments conducted without proper hygenic precautions sound men are rare after a few years' work. The prevailing cause of death is consumption, which usually overtakes a susceptible worker so early that his period of usefulness does not extend much beyond five of six years, except where the health is properly safeguarded.



Trunnion Exhaust from Tumbling Barrels

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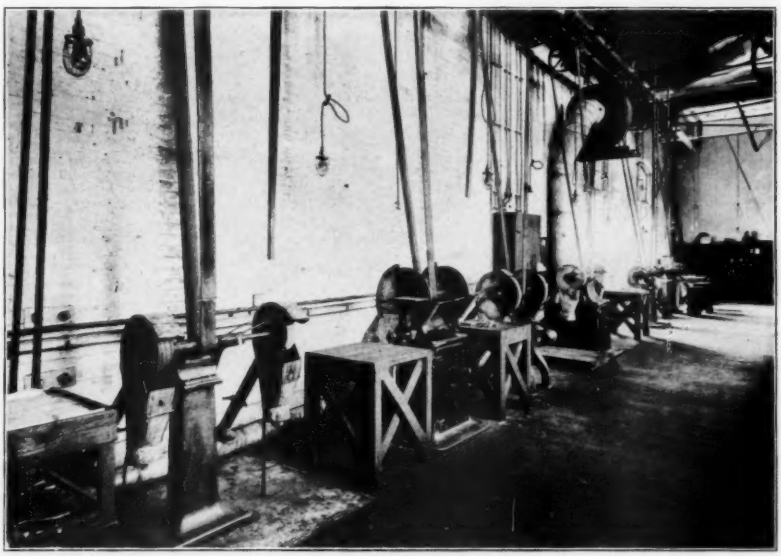
The testimony of physicians is, that of those employed in this industry nearly all who reach the age of forty die of consumption, excepting those who succumb to some acute disease. As proof of this statement, it is instructive to note that in Northampton, Mass., an important seat of the cutlery industry, the death rate from tuberculosis for the entire male adult population was 2.9 per thousand, while that for the cutlers of that town was four times as great, namely, 11.8 per thousand. The trouble lies not so much in any directly poisonous results from inhaling the dust as in its power to bring about constant irritation, which produces such a condition of the mucous surfaces that they more readily admit of invasion by disease germs. Fortunately brass is less irritating than steel, and consequently the results in the brass industry are not as disastrous as they are among the cutlers. But the dust of corundum and emery is peculiarly irritating, and the brass workers' surroundings are therefore susceptible of marked improvement.

Laws to Safeguard Health.

The unhygienic conditions existing in the various industries have received the attention of State Boards of Health, whose official investigations are bringing about the passage and enforcement of more stringent laws looking to the safeguarding of the health of the employes in all industrial establishments.

In a word, advance has been made from a matter of individual interest to one of almost national importance. The statute books of the leading states of the Union already contain laws, usually somewhat vague in their expression, which require cleanliness, light, warmth, ventilation, and the introduction of specific devices for removing dust, fumes, and the like. While the first impulse of the manufacturer may be to resent the enactment of further laws, yet his compliance with them is not without eventual advantage. Not only will a better class of men prefer to work for him if improved conditions are provided, but there will be far less interference with work because of sickness, more energy in the work which is done, and less loss by death, of the potential value possessed by the man who has become thoroughly skilled in a given line of work



A Model Exhausting Arrangement, with Main Pipe on Floor

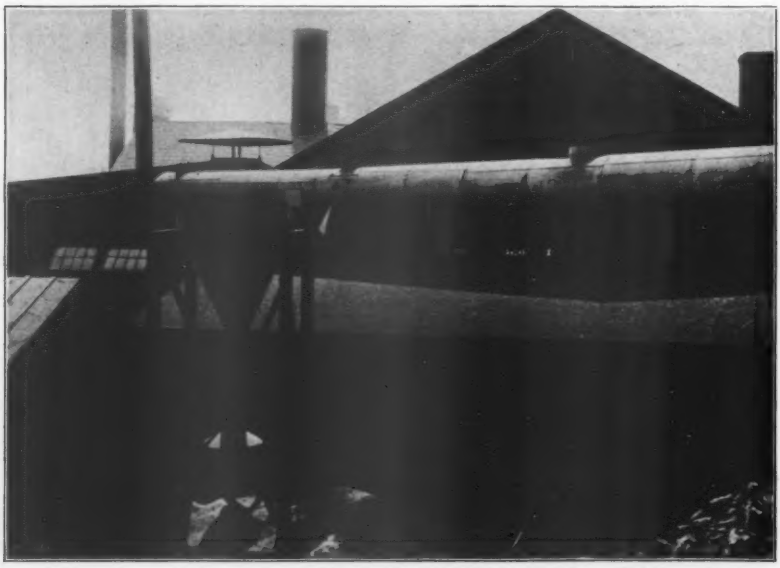
Continued sickness and death naturally mean constant replacement of individuals, with the loss of knowledge and skill gained by those who have gone. As a result there is far less stability of employment in an unhealthy industry.

Ventilating Appliances.

Experience has shown, and the reports of investigations confirm the fact, that mechanical means are absolutely necessary to maintain a rapid air change or to insure proper removal of dust. In fact the fan blower figures everywhere as the only device adapted to secure these results. It is manifest that the action must be positive, and of sufficient intensity to create ample movement of air. Where there is but little dust or the requirements of ventilation are slight, a fan applied for mere renewal of air throughout the entire extent of a room will meet the requirements. When warranted by the size of the plant the fan may form part of a blower heating system, by means of which warm air from a centralized heater is delivered under pressure through pipes to all parts of the building. In overheated rooms and particularly for summer ventilation the disc or propeller type of fan meets the requirements if placed in wall or ceiling.

Wherever dust or fumes are formed locally, as in connection with grinding and polishing wheels, tumbling barrels, or furnaces, the exhaust should be direct from hoods which enclose the objectionable source as completely as possible. In a word, prevention is better than cure. The objection which is often shown by workmen to hoods and similar contrivances—even to the extent of actual destruction—is largely due to their improper construction. In fact the cause for condemnation or criticism of many exhausting systems lies in the method of application of the fan, and not in the fan itself. The success of the fan not only depends upon its speed and its proper proportioning to the work, but also upon the system of piping and hoods which would give the greatest efficiency. It seems so simple to employ a local tinsmith to rig up an exhausting system that it is not strange that unsatisfactory conditions result.

It is far better policy to secure the



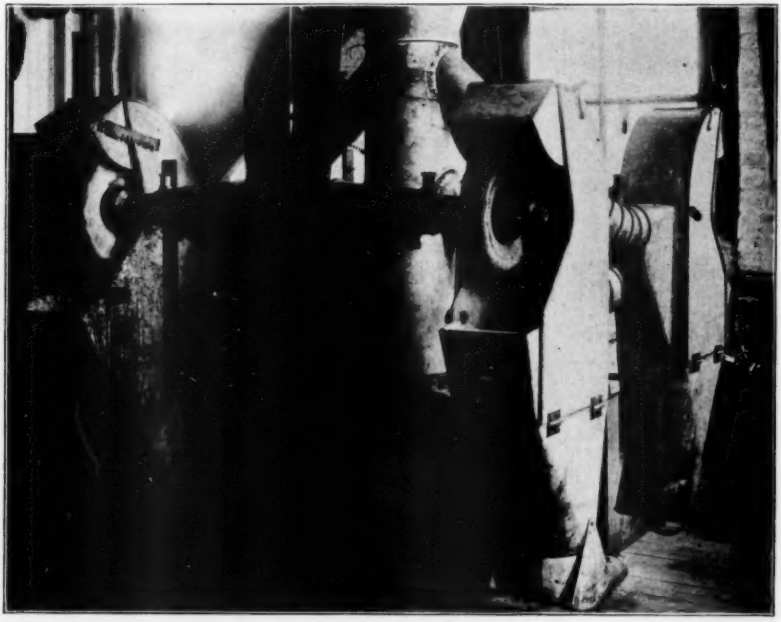
ARRANGEMENT OF DUST COLLECTOR WITH CLEAN-OUTS IN PIPE AND FREE DUMP FOR DUST

best advice, which will always be freely given by blower manufacturers, and then have the thing done right. It must not be overlooked that the installation of an economical exhausting arrangement requires definite engineering ability, and should only be undertaken by one who makes a specialty of this particular class of work.

Cost of Installation.

Because of the lower first cost the user is always strongly tempted to buy the smallest apparatus that can be made to do the work. But first cost is only one of the factors in the total cost. Large slow running fans with ample pipe areas are conducive to small power expenditures. It is easy to save enough in power in six months to pay the additional cost of a more efficient outfit or system. Thereafter its economy is all clear gain.

Even though the fan be of ample size when first installed, it may, as a result of speeding up to meet added requirements, frequently demand from 50 to 100 per cent more power than would be necessary to do the work with a proper outfit. It is none too generally understood that the power required to drive a fan increases as the cube of the speed. In other words, that doubling the speed calls for an eight-fold increase in power, while 27 times the power is required at three times the speed; an increase of only 25 per cent in speed calls for nearly double the power, and yet such an increase is common enough. How long would it take to pay for a new outfit from the money thus squandered in excessive power?



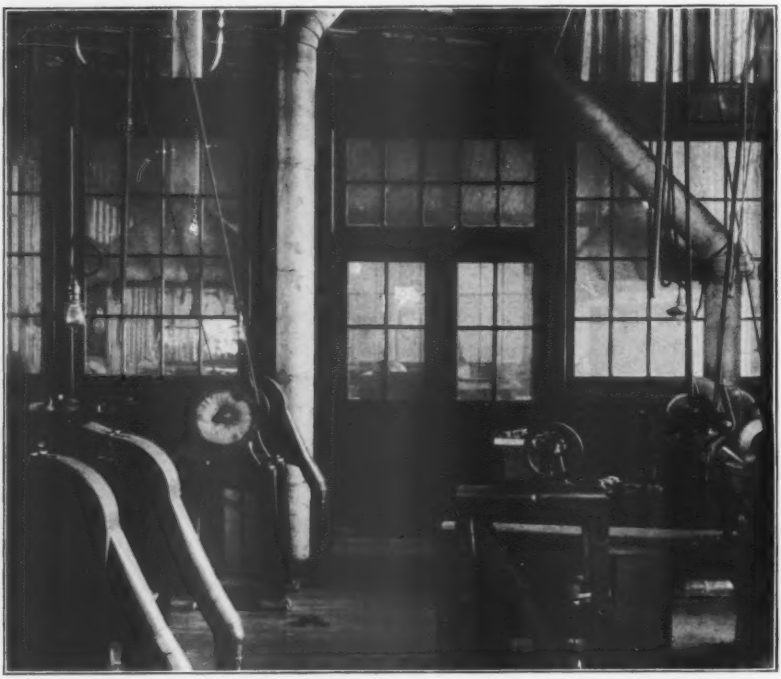
ARRANGEMENT OF HOODS FOR UPWARD EXHAUST

Design of Hoods.

The designs of hoods for grinding, polishing, or buffing wheels are many and varied. Each must be arranged to suit the particular class of work for which the wheel is used. In some cases it is even necessary to have several different types in the same room. This is true where the pieces are of such shape and size that it is impossible to get very close to the wheel, the result being that

at one time the operator uses the wheel at a point near the top, and again at a point directly underneath. Under these conditions especial care must be taken to provide the most effective type of hood and maintain the maximum blast. In heavy work of this type the air suction pipe should be five inches in diameter for wheels up to and including 16 inches in diameter by three-inch face. In ordinary grinding and buffing rooms the suction pipes should be four inches in diameter for wheels 2½ inches or less in width, and from 10 to 18 inches in diameter. Wheels ranging from 19 inches to 28 inches should have five-inch or six-inch pipes according to class of work for which they are used.

All hoods should be so designed that the velocity through the openings should not be less than 5,000 feet per minute, which is usually sufficient to create the draft necessary to carry away the particles. The best general type of hood is of patented form, provided with a receptacle below to trap out all heavy particles, as well as the threads from the buffing wheels, while allowing the finer dust to pass through the pipe. The result is that the metallic particles are left in clean condition ready for resmelting, and the wear on the pipes and the fan is greatly reduced. This arrangement also prevents the annoyance caused by the dust from the rag wheel adhering to the fan wheel and throwing it out of balance. The trapping-out feature furthermore permits of the ready recovery from the bottom of the hood of any small piece of work or other material, which with other types of hoods might get into the main trunk line or up into the fan.



EXHAUSTING ARRANGEMENT WITH PIPES CARRIED BENEATH THE FLOOR

All properly designed systems should have clean-cut caps so as to provide free access to the interior of the piping for the removal of anything that might possibly tend to clog it. The main suc-

GRINDING DISCS EQUIPPED WITH SPECIAL HOODS DESIGNED TO GIVE FREEDOM TO WORKMEN

tion pipe should be proportionately increased in size as each connection is made to it.

Fan Installation.

To secure the most economical results a fan should be chosen which has an area of inlet about twice the combined area of the inlet pipes. This proportion will give the maximum velocity through the branch pipes and hoods. The fan should then be operated at about 1½-ounce speed, under which condition it would consume about ½-horsepower for each four-inch opening.

The most work is done, and consequently the most power is required by a fan when it is discharging with free inlet and outlet. The more extended the system of piping, the smaller the area of inlet or outlet; and the greater the friction, the less will be the volume delivered by the fan; and consequently the less will be the power required to drive it. It is therefore manifest that the fact that the fan is consuming but little power is not always evidence of its successful operation, for it may be doing little effective work.

The dust which is collected by the fan should be discharged into a centrifugal

BUFFING LATHE WITH SPECIAL FORM OF TRAP HOODS DESIGNED TO AVOID INTERFERENCE WITH SHELF

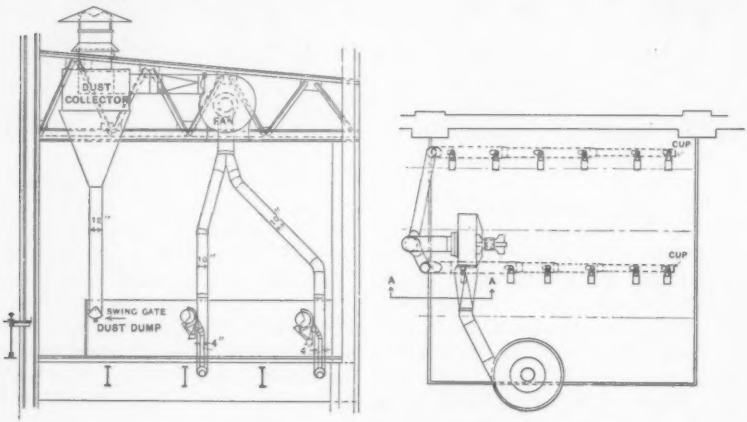
dust collector. Here the dust is separated from the air by centrifugal force; the air escapes from the top practically free from dust, while the dust itself drops out of the bottom through a pipe. It should be periodically removed. The dust from wheels grinding iron and steel should not be mixed with that from rag wheels, for in some cases fire will result. Separate fans and systems should be used.

Exhausting from Tumbling Barrels.

The same general principles hold in connection with systems exhausting from tumbling barrels. If the maximum effect of the fan is desired on tumbling barrels equipped with hollow trunnions, the area of fan inlet should be about double that of the sum of the openings in the trunnions. The sizes of pipes and the speeds of fans to be applied in connection with housed rattlers must depend largely upon the conditions, but a six-inch pipe connection will usually serve for each tumbling barrel, if the same is tightly enclosed. A fan running at about one ounce speed will give sufficient draft.

No general rules can be given for the application of the fan system to sand-blast rooms or apparatus. The arrangement must depend entirely upon the local conditions, but the provisions must be generous if successful results are to be obtained.

With installations such as are here described it is possible to maintain a relatively healthy atmosphere, which is bound to insure better work. Between the humanitarian spirit of the employer the financial advantage of healthful conditions, and the requirements of the law, there is certainly no reason why healthful conditions should not be found wherever the brass industry is pursued.



A TYPICAL EXHAUSTING ARRANGEMENT FOR BUFFING WHEELS, WITH PIPES BENEATH THE FLOOR

NOTES ON BRONZE CASTINGS

By C. E. Johnson, Dorchester, Mass.

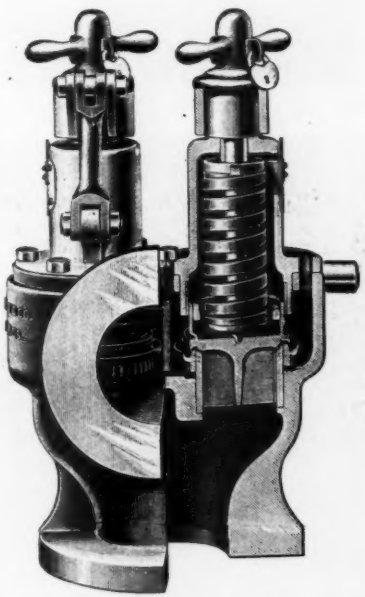
In connection with the new Association of the Brass and Bronze Founders to be formed, I might say that a gathering of founders in these lines is very much needed, for there are so many questions to be solved that only interchange of thought and experience will save loss and annoyance and improve the industry as a whole.

While the cry of the finishing room is always directed against the foundry, in the case of defects, yet the difficulties which beset the foreman there are very troublesome. I give a few instances to show the need of further investigation along the lines of the metal itself and the manner of molding and pouring.

In casting very heavy valves for U. S. battleships, the unequal expansion of the solid nickel seat placed into the bronze valve caused much trouble, as the nickel seat would get out of round under pressure. The nickel was 4½ inches by 6 inches, and when finished was tested at 175 pounds pressure. It was then placed into the valve and tested at 200 pounds pressure. The illustration shows how high the nickel seat stands from the body.

After trying various alloys to replace the nickel, with no better success, the seats were reground again and again, taking them off each time, until finally after half a dozen trials the valves were made tight. The best results were obtained with the valve body of a bronze with no zinc, and solid nickel seats.

Again we had to make some castings weighing 200 pounds each, about 2 feet long, one foot in diameter, and ½ inch in thickness all over. There would always be trouble with leaks at the flanges. Whether we cast them flat or on end with flange down, the result was always the same when tested under 500 pounds pressure. Finally, we cast the bodies with flanges up, and got perfect results. This shows how the method of molding has much to do with the result. The metal was cast as hot as possible without burning.



Valve Section Showing Height of Nickel Seat from Body

SOME FACTS CONCERNING FOUNDRY TRADE SCHOOLS

By W. W. McCarter, Marietta, Ga.

The tendency of the industry, as unerring as the force of gravity, determines the mechanic working therein. Only the latest improvements command the market, and the law of supply and demand keeps out the reinvention of long abandoned methods and processes. The world moves on.

The subject of technical instruction, dry in itself, is nevertheless of paramount importance. I am indebted to our friend Mr. Lane, who writes me as follows on the subject of Foundry Schools: "Thus far no feasible means have been presented by which a practical school which would turn out molders could be successfully operated. There have been many propositions advanced, but thus far little practical results have been shown. Due credit should of course be given for this work, but so far as turning out practical molders, rather than shop superintendents, the result has yet to be seen."

The subject, in order to be better understood, should be investigated closer. The difficulty seems to lie in the way it is handled. Our young men may grow up within an atmosphere of active thought and intelligent cultivation, and all their powers be keenly stimulated. Just by as much as they are ardently interested, by just so much are their minds full of their occupation. There is a natural bent to every one's endeavors. If he leans toward the foundry, encourage him in this, and he will make a success of it. Give him literature on the subject, as well as other matter for his edification and instruction, and let him feel and know that his interests are in common with those of his employer.

Molding Hoisting Engine Cylinder. Seniors 1 and 2, Junior 3

Two Days' Output.

I will make a brief synopsis of a school I am now operating on a commercial basis. In order that an intelligent idea may be obtained of the nature of the work produced and its character, I will

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RUBBING BED MOLD. THE ROUGH CASTINGS WEIGHED 10½ TONS

enumerate the total items contained in a two days' heat, March 11 and 12, as follows:

Six wind boxes for the Tennessee Copper Co.

Two screw frames for gang saws, movable worm.

Forty journal bearings for marble trucks.

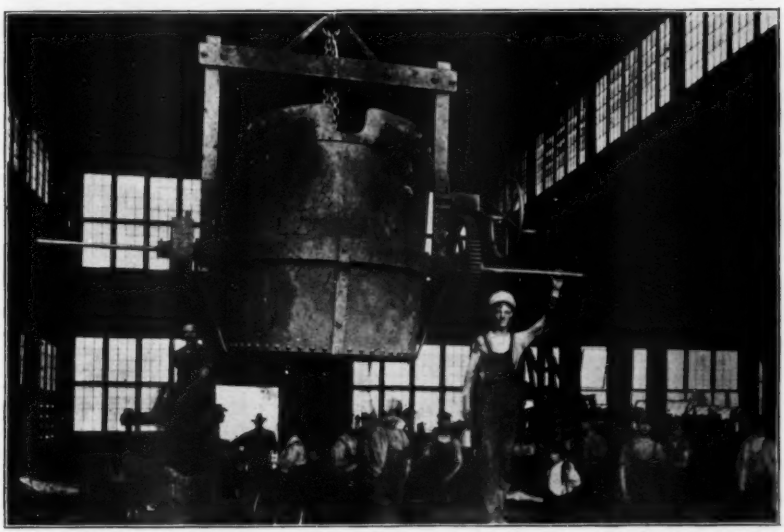
Nine 20-inch driving wheel centers for locomotives.

Five 22-inch driving wheel centers for locomotives.

One 40-inch driving wheel center for locomotives.

Two sections, troughs, for rubbing bed.

One large sand pump base.



ONE OF THE LARGE LADLES

One friction flange for hoisting engine.

Twelve driving boxes for 8-inch x 14-inch locomotives.

Four steam chests.

Four covers for rubbing bed troughs.

Five valves for steam brake.

One pedestal for sand pump.

The total weight of good castings produced in this heat was 8,940 pounds. In addition to the items enumerated, there were two 8-inch x 14-inch locomotive cylinders molded up and placed into the core oven, subsequently cored up and cast the following heat. The result of the heat just enumerated was as follows:

Good castings, pounds	8,940
Bad castings, pounds	60
Remelt, pounds	600
	9,600

Total iron melted, 10,186 pounds; melting loss, 586 pounds; coke ratio 1 to 8. The entire cost of labor for the two days was $47.10. There are at present six "seniors" and eight "juniors" in my school. It will therefore be seen that the heat was produced by fourteen students. It is pertinent to state that the "freshmen" are an initial expense to the school, yet I have included the entire cost of labor, regardless of the divided employment of the remaining six "freshmen."

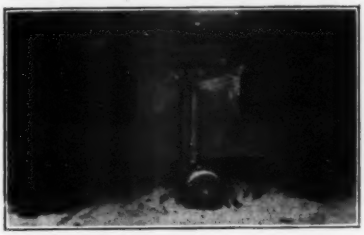
Number of Students.

Twenty students comprise the school at the present time, exclusive of two colored men who work about the yard, cupola, and cleaning department, etc. The twenty pupils are divided into three classes as indicated above. The seniors are producers, the juniors semi-producers, performing the part of the ordinary helpers, and participate in the ramming and drawing of patterns. The freshmen go through the regular routine of lining up ladles, charging the cupola, the core room, following up the two classes which have preceded them.

THE CUPOLAS

The entire force of students are from time to time given diagrammatical instruction, and examples to work out, and are expected to go over these matters during the evening, and bring their report in the morning, whether right or wrong. They do this readily and are anxious to learn.

Rubbing beds for marble works being



LARGE CASTING MADE IN THE FOUNDRY

our specialty in loam work, are executed by the juniors and freshmen. The green sand is kept for the seniors. Dry sand work is of secondary importance to them, though they make all locomotive and hoisting engine cylinders in dry sand.

Sole plates weighing 3,500 pounds each are made in dry sand by the juniors and freshmen, dried over night and cast next day. Two juniors and two freshmen make one sole plate per day. The same number of men make one rubbing plate in four days, the weight being 9½ tons.

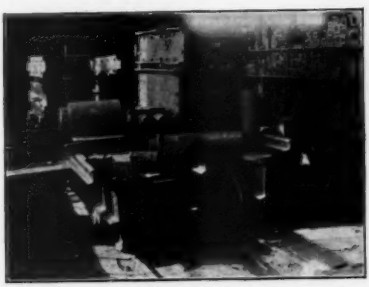
The items enumerated in the above heat are only a part of the variety of work performed, and while the percentage of loss in the heat given is very small, it is seldom higher at any time. Only when a junior is promoted to the senior grade does the percentage of loss go up temporarily.

Tuition.

The pupils of this school, unlike others, are paid to attend. The present rate of wages ranges from 40 cents to $2.00 a day. The rate of pay increases in proportion to the earning power of the student regardless of the time he has served. The ages of the present students range from 12 years to 31. Their age has also nothing to do with their pay and advancement. For instance, one young man of 16 years now receives $1.50 a day, a man of 31 gets $1.25. Both have been recently promoted to the senior class. In advancing their wages, when the rate reaches $1.00 per day, 10 per cent of this is charged the student for instruction thereafter. This, however, is not applicable in every case, thus the man of 31, who has a family, will advance before he is charged for instruction. The school is now over a year in existence and doing very well.

The author has written several papers for the press on this subject, and believes that work of this kind in a foundry can be aided greatly by the correspondence schools, when the foreman takes pains to add his advice and counsel.

Firms might subscribe a small amount annually for such instruction papers, and give the information to their apprentices, aided by the foreman, and get splendid results. In this way will the bringing out of more skilled workmen for the foundry be stimulated and much good be done the industry.



CORE BUGGY

SMALL THINGS OFTEN NEGLECTED IN THE CORE ROOM

By H. M. Lane

In too many foundries the core room is either considered a necessary evil, or is looked upon with such contempt that it is simply allowed to shift along any old way that it can. Core makers are too frequently ignorant of the real reasons or principles underlying their trade, and do not understand or appreciate the advantages of different binders, different methods of making cores, etc.

No universal rules can be laid down for governing the core room and its conditions, as the quality of sand available and the character of the work will, to a large extent, determine the most efficient method of carrying on the work.

In some cases a local sand of poor quality can be used to produce cores at a lower price than they can be produced by shipping in sand of a better grade, providing the proper binder is selected and the proper amount used.

It is just as bad core practice to use too much binder as it is to use an insufficient quantity, and there is no universal binder which will fit all cases.

Binders.

For cores which are to be kept in stock for some time, a binder must be selected which will not draw or absorb dampness, or else the storage room must be kept at such a temperature and under such conditions that it will keep the cores dry. One may find that he can use flour or molasses to advantage, and then arrange his storage room so that it is heated with stoves, or waste heat from the ovens, by locating the storage rooms over the ovens. Another may find that it is cheaper to use resin, oil or some compound which does not absorb moisture, such as one of the dry mixtures now on the market. All of these conditions must be carefully considered when selecting a core binder.

It is exceedingly easy to fool not only the boss, but yourself in experiments conducted to determine the best binder. Some of the points to be considered are the cost of the sand, the cost of the binder, whether the use of a given binder makes it more or less difficult to make the core, what effect it has on the drying, what effect it has on the storing and what effect it has on the percentage of castings lost. Some binders are very satisfactory for light cores, but totally unsuited for use in heavy cores. Then, on the other hand, one core maker will make heavy cores with a given binder which are as perfect as anyone could desire, while another will fail utterly, on account of the fact that he does not understand how to open up or vent the interior of his core with the use of coke, wax strings or other devices.

Core Machines.

In cases where a large number of stock cores are employed, there is more of a chance for saving than there is in a general jobbing foundry. In the first place, the cores having a uniform cross-section, whether it be circular, rectangular or of any form such as a section of an oval, can be made to advantage on a core machine of the sausage stuffing type—that is, a machine which feeds the material out in a continuous stream by means of screws.

For exceedingly small cores—that is, below 3/8 inches in diameter—special machines have been devised which make cores by a combined screw feed and plunger feed.

The cores which can be turned out the cheapest by machinery are the medium sized cylinder core or prismatic forms.

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In steel foundries and other establishments using a large number of covering cores, the slab core machine will be found a decided money saver.

The multiple spindle core machine will also be found advantageous where a large number of cores of uniform size or character are required.

For irregular cores of small size which are required in large quantities for pipe fittings, hardware, valves, small machine parts, etc., all metal core boxes should be used, and a mixture employed which requires but little ramming. A core mixture made with oil and sand can be rammed by simply jarring the core box on the bench. Where wires are required in cores of this kind, care should be taken to see that they are so located that they can be easily removed from the castings during the cleaning process. Ordinary wire, such as can be purchased on the market, is not well suited for core wire. A soft or annealed wire is too soft, while the hard drawn wire is too hard and brittle. Where only a comparatively small amount is used, it is well to use soft iron wire, but before using, the wire should be stretched a certain amount, to harden it. A handy device for this purpose can be made by arranging the wire so that it can be clamped at one end and then providing some drawing mechanism, about 6 feet from the clamp which will stretch the wire from 3 to 4 inches in six feet. The drawing device can be in the form of a lever carrying a clamp, or it can be a rack and pinion. This stretching of the wire greatly increases its stiffness, and enables it to hold up or support the core much better.

There is at least one wire mill in the country, however, that understands the core room conditions perfectly and can furnish wire which has been drawn to just the proper degree of hardness, and when large quantities are required, it will pay any foundry to buy such specially drawn wire.

Metal Core Boxes.

Metal core boxes for constant use, and especially when of small size, should be made of a high grade pattern bronze, as this will not tarnish or corrode and is of such a character that the core leaves the box freely. The designating numbers or marks upon the box should be so located that the thumb or fingers will be rubbed over them when the box is in use, as this will keep a bright spot where the mark is located, which will always make it easy to see. If the mark is located on some other part of the box, it is liable to become gummed up so that the number is difficult to read.

One point that many core makers do not give proper attention to is the amount of moisture used in tempering sand. Sand should always be worked as dry as possible, for every pound of moisture introduced must be evaporated in the core oven. The evaporation of this moisture takes fuel and costs money, hence the use of an excess should be carefully avoided. Machine made cores have one decided advantage over hand made product, and that is that the mixture may be worked much dryer in the machine than by hand—in fact, only about half the water is required in the machine made cores.

Testing Cores.

In testing machine made cores, to see whether or not they have been properly baked, there is a simple device which can be used. This consists in the introduction of a bright steel wire, such as a machine vent wire, into the hole in the end of the core. If the core is thoroughly baked, the wire will come out dry, but if the core contains any moisture, the wire will be moist when it is withdrawn.

It is in the making of the little cores which are used in large quantities that the biggest saving can be effected in the average foundry. It is easier to cut the cost of these cores in two than it is to make the like percentage of saving in the production of the large cores, and hence the up-to-date foundry superintendent should give especial attention to the best method for turning out the small and medium sized cores.

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In attacking the problem of how to reduce the core expense, one of the first things to be considered is the best method of making the core. The first factor to be considered in this point is the number of cores to be produced, and next, their form. If the number is very great, and the form regular, they can be produced on a standard core machine, and it pays in all cases where it is possible to standardize the cores. If the number is great and the forms are irregular, they may in some cases be made on a standard machine, but subsequently cut, formed or pressed in suitable dies; but in most cases it will be necessary to use specially formed metal core boxes.

Core Room Methods.

To further reduce the cost, the arrangement of work in the core room should be carefully considered and systematized as far as possible. In a large core room the core maker should never have to leave the bench at which he works, but should be supplied with properly prepared sand, and should have all of the cores removed as fast as they are completed and carried to the oven. After the cores are baked they should be passed to the foundry or to storage by some one who makes this his especial duty.

Baking Cores.

The matter of drying or baking cores is exceedingly important. Some cores require a very much higher heat than others. Where a binder like flour is used, it is necessary to actually bake the flour, and hence the temperature must be at least that used for baking bread. If the core is intended for steel castings and it is considered necessary that it be rotten in texture, a sufficiently high temperature must be used to practically burn the binding material.

Where one of the dry binders made from pitch or resin is used, a sufficient temperature is required to render the binder fluid so it will flow through the body of the core and thoroughly unite the particles of sand. In the case of resin or pitch binders, some of the volatile products of the resin or pitch are driven out during drying, but this is not an important factor in the reaction which takes place.

In using molasses or flour, the process of drying is first one of the evaporation of moisture, and second, of a baking or changing of the bonding material. In the case of oil binders the baking process is essentially an oxidization process. A linseed oil core will harden at atmospheric temperature if allowed a sufficient length of time. Linseed oil is the basis of most paint, and paint hardens by the oxidation of the oil. The process which takes place in an oil core is very similar indeed. The baking of an oil core is simply a hastening of this oxidation process.

In any core baking process there is considerable moisture to be removed, as well as the chemical reactions to be brought about, and hence a good circulation of air in the core ovens is highly essential.

The thermal or heat efficiency of core ovens could be very greatly increased if the waste heat of the ovens were used for partially drying the cores. This has been done in some foundries, the truck of cores being run into one oven where they are dried and then to another where they are baked. Where this is done, one point requires careful attention, and that is to be sure no attempt is made to dry cores beyond the point where the hot air escaping from the oven is saturated with moisture or has reached what is commonly known as the dew point.

The fuel to be used in drying cores has an important bearing on this subject. While natural gas forms a very fine fuel for many purposes, it would not form an ideal fuel for this last mentioned system for drying and then baking cores, on account of the fact that one of the principal products of combustion of natural gas is water, which condenses into steam, as the gas contains a very large amount of hydrogen. Coke forms an ideal core oven fuel as the products of combustion contain practically no moisture, and hence have the greatest drying power.

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THE ART OF GALVANIZING

By Alfred Sang, Pittsburg, Pa.

One of the most persistent problems which confront the worker in iron and steel is the prevention of corrosion. We cannot rid ourselves of the agents which effect the corrosion of iron without at the same time ridding ourselves of the agents which are essential to life itself. Air is indispensable both to human respiration and for the formation of rust and other oxides for which it supplies the oxygen; moisture is necessary for the formation of clouds which make the earth fertile, and it also supplies the medium in which rusting takes place and hydrates the oxide; carbonic dioxide is an animal by-product and a raw material for the vegetable world, and the exchange of carbonic dioxide and oxygen, which is continually taking place between the animal and vegetable kingdoms is of vital importance; then, on the other hand, rust is not readily formed—if at all—unless there be an acid present, and the acid which is most universally distributed is carbonic acid or hydrated carbonic dioxide. There is, as you see, a close relationship between the processes of living and rusting, but while human beings make up for the rusting or decaying of their tissues by nutrition, it has not yet been discovered how to feed or regenerate iron, and until such a discovery is made we are compelled to take our cue from the ancient Egyptians and resort to embalming.

Methods for Protecting Iron and Steel.

There are two general ways of embalming iron to prevent its decomposition, which might be called respectively the non-metallic and metallic methods. In the non-metallic method, the articles are coated with an organic substance, usually oil or varnish, the efficiency of which depends on its being more or less air tight; when coloring matter is added to the oil it becomes a paint, but I understand from authorities on the subject that a varnish free from pigments is preferable to anything else. The metallic method consists in coating the iron with some other metal, and it is this method which I have come to discuss with you.

The Composite Nature of Steel.

Iron rusts less readily than does steel; this is perhaps due to steel being a very composite material. In the iron, which forms the bulk of its composition, are dissolved or immersed a great variety of other substances; some of these are simple, such as graphite, silicon and manganese, and others are compound, such as carbides, sulphides, phosphides and silicides; the carbon compounds are very numerous and diversified, being due to different heat treatments; the best known are cementite, pearlite and martensite. Just as variety is, to some people, the spice of living, so is heterogeneous composition the spice of rusting, in the present instance at any rate; nor is this by any means a solitary instance; it is a well known fact that chemically pure zinc is dissolved very slowly by certain acids, whereas the commercial product, especially if it be high in iron, is rapidly dissolved.*

When steel is attacked by an acid pickle its surface is due to the iron dissolving first and the impurities being left as a poorly adhering black powder. For some work which has to be coated, and especially if the coating is non-metallic, it is desirable to remove the surface "rottenness" by means of the sand-blast; the sand-blast is often inconvenient or undesirable, but a high pressure water jet is also effective and will remove at the same time the gelatinous or colloidal salts of iron which are left on the surface of the steel.

Metallic Coatings.

If the metallic coating is considered merely as a garment which protects the

* The theory has been advanced by Weeren that this passiveness of pure zinc is due to the formation of a condensed layer of hydrogen on the surface, which prevents further action of the acid. It is difficult to see how the presence of iron would prevent the accumulation of hydrogen.

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iron article from atmospheric influences, the points which must receive special consideration are the closeness of the fit and the impenetrable qualities of the coating. A close fit is more readily obtained by depositing the metals electrically. In hot processes the uneven contraction of the coating and coated metals—the latter usually having the lower coefficient—will cause blisters which are not always noticeable to the naked eye but which are none the less present. This poor adherence due to uneven contraction is evidenced by the flaking which will take place when the articles are bent; with articles which do not undergo bending, such as castings, there may not be any flaking, but the air spaces are there just the same and oxidation will take place under the blisters, out of sight, slowly but surely, if the air is given access. Unfortunately the air has free access to these spaces because no hot coated surface which has not received a mechanical treatment in the hot state, such as rolling, is free from faults and crevices; especially is this the case in rough and irregular work like castings where the variety of strains taking place at the moment of setting of the coating metal produce an equivalent variety of microscopical fissures. Through these fissures the air, moisture and carbonic dioxide have free access to the iron.

An electrically deposited coating adheres a great deal better than does a hot coating, and this is the greatest point in its favor; unfortunately, it is almost impossible to obtain a surface free from pores. Every photographer knows how specks of dust will cause pinholes in his negatives; a particle of dust is more or less light-proof and protects the point of the film on which it rests from the chemical action of light. In electrolytic work each speck of impurity prevents the metal-ions of the electrolyte from depositing on the spot covered by the impurity and a pinhole or pore is the result. These pinholes are like wells with a spot of rust, a speck of dirt or a particle of oil at the bottom, each of which is sufficient in itself to prevent the deposition of the coating metal, but none of which is able to prevent the access of the corroding agencies. Under the microscope rust will be found to originate in all cases in the pores, and I have examined specimens where the rust seemed to fairly ooze out of them. If articles could be made perfectly clean before being coated, the electrolytic process would be perfect as regards the two points of quality required of a coating considered as a covering only.

The Coating as a Mechanical Protection.

Considered merely as a mechanical protection, the coating should be resistant to impact and to abrasion, the latter being the most important. The soft metals, such as tin and zinc, do not stand up well against abrasion, but unless their adherence be very defective, they will stand impact well, on account of their malleability at ordinary temperatures. It would be desirable to obtain a coating which would be as good a protection as zinc but tougher and harder. Aluminum is being used with some success and if the metal were cheaper it would become an interesting competitor of zinc.

Different Behavior of Tin Plate and Galvanized Iron.

But there is a more important feature of metallic coatings to be taken into consideration. This feature I shall introduce by the following example: If you make an incision in the surface of a sheet of tinplate and a similar one in a sheet of galvanized iron and expose the two sheets together to the same oxidizing agencies, you will soon note a very great difference in the behavior of the two mutilations. The cut in the galvanized iron will rust very slightly or not at all and the zinc at the edges will be oxidized, but the cut in the tinplate will not only show much more rapid and intense oxidation of the iron but the corrosion will extend beyond the edges of the cut, and in spite of the tin. A pinhole in a galvanized sheet will not rust; a pinhole in a tinplate will spread out like a star.

Metals in Contact.

I must now call your attention to a few scientific principles which are all-important when considering metallic

coatings. In order to understand the reason for the different behavior of the galvanized iron and the tin-plate, it is necessary to thoroughly understand what takes place when two metals are in contact. For the purpose of the present discussion we must consider four cases of metals in contact as follows:

First—In the presence of electricity.

Second—In the presence of heat.

Third—In the presence of corrosive agents.

Fourth—Apart from any exterior agency whatever.

In the Presence of Electricity.

As regards the first case, it is important to note that copper conducts electricity better than does iron, iron better than tin, tin better than lead, lead better than zinc and zinc better than antimony. The metals first mentioned are negative to those which follow; iron is negative in relation to zinc and zinc is positive in relation to iron. The conductivities of these metals are the reciprocals of their resistivities, in other words, the better conductivity of copper over iron is due to the smaller resistance which it opposes to the passage of the electric current. Again, the better the metal conducts electricity the less capacity it has for storing it; this is the same as in the case of heat, the poorer the body as a conductor, the more difficult it will be to heat it, but the longer it will take to cool. The wooden handle of a silver teapot does not heat up as well or as rapidly as does the pot itself, but when the teapot is cooled the metal part cools quickest and becomes colder than the handle. If, now, two metals, say iron and zinc, are put in contact and immersed in an electrically charged medium, the iron being the better conductor will not absorb as much electricity as the zinc, and there will exist what is known as an electromotive difference of potential, there will be a difference of electrical pressure between the iron and the zinc in contact, and therefore a steady current of electricity will flow from the zinc to the iron, and this current will be kept steady by the leakage which is directly proportional to the absorbing power. If no leakage were possible the potential of the two metals would reach the same level and they would be in electrostatic equilibrium equivalent to a closed circuit.

An apt comparison to what takes place would be that of two water tanks of equal dimensions, connected at the bottom and at the top by open pipes, and one tank having a larger intake at the top than the other; if both tanks are filled simultaneously by steady streams of water, the tank with the larger intake will fill more rapidly and there will be a continual flow through the lower connecting pipe from the tank with the larger intake to the tank with the smaller intake to maintain the level. When the tanks are full they will be in equilibrium, and if they are turned upside down the outflow through the intake pipes will be proportionate to the previous inflow and the current will be reversed, passing from the tank with the smaller outflow to the tank with the large outflow in which the level is going down more rapidly. It is this operation of maintaining, or rather the effort to maintain the electrical level which produces the flow between metals of different conductivity when they are in contact and immersed in an electrically charged medium. The medium itself may be perfectly static, or at rest, but the flow from the iron to the copper will manifest itself as dynamic, or moving electricity; nothing in nature, be it material or immaterial, can be manifested to our senses unless there be a motion, a difference, a relation.

Electricity is always present on this planet, and everything is fairly impregnated with it, if, therefore, we bring two dissimilar metals into mutual contact we shall obtain a flow of electricity from one to the other, caused by an ineffectual effort to equalize potentials, which will produce sensible galvanic effects. The contact need not be direct; a suitable conducting connection, such as moist air, will act as an electrolyte and enable the action to take place, the space in between constituting what is known as a field of force. Besides atmospheric and telluric electricity we are often called upon to take into consideration, in our engineering problems, the electricity artificially produced for industrial and domestic purposes, the diffusion of which, or "stray currents" as they are called,

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will hasten the corrosion of water pipes and structural steel, even when they are embedded in concrete.

The reverse of the order in which I have previously placed the metals in relation to their conductivities—i. e., antimony, zinc, lead, tin, iron and copper, indicates the positive direction in which the current will flow from metals having the higher to those having the lower potentials; it is known as an electromotive series.

In the Presence of Heat.

The second case is that of metals in contact exposed to heat. The electrical conductivity of substances will vary with temperature, that of metals decreasing with an increase of temperature. There are notable exceptions to any generalization which might be attempted that the conductivity is inversely proportional to the temperature, and one of these exceptions happens to be iron.

When two metals in contact are subjected to heat the voltaic or galvanic action of which I have spoken will be influenced either favorably or unfavorably because the thermo-electric series is different from the electro-motive series which I have given you. The thermo-electric series runs as follows: lead, tin, copper, zinc, iron and antimony. The order of these metals indicates the direction in which the current tends to flow with an increase of temperature, this tendency may be, and is in most cases, exhibited as either a resistance or as an aid to the electromotive current; for instance, increase in temperature will reduce the current from zinc to iron in a lesser degree than from antimony to iron. This principle has been used in the construction of electric pyrometers in which the variation in the temperature of a couple formed of dissimilar metals is recorded very sensitively at a distance from the source of heat, by means of a galvanometer.

The galvanic effect between metals is, therefore, modified in a very complicated manner and to a considerable extent by the temperature at the point of contact. This galvanic action seems to be intimately related to the natural tendency towards chemical action exhibited by all substances in contact and to that chemical affinity which exists to some degree or other between all kinds of matter.

In the Presence of Corrosive Agents.

The third case is that in which corrosive agents are present which attack both of the metals. A decrease of electrical potential seems to aid chemical action and an increase of this potential opposes it. The metal towards which the flow of current is directed is, so to speak, over-saturated on account of the persistence of effect which, when it refers to magnetism is called hysteresis, and its potential is greater than normal. The flow of current from zinc to iron will over-saturate the iron and will prevent its decomposition, when it is exposed to corrosive influences, whereas the zinc which is under-saturated is in poor physical condition to withstand chemical attacks. It will decompose into oxide and carbonate more rapidly than if it were out of contact with the iron. If only one of the metals is attacked by the corrosive agents under normal conditions, there will be no galvanic protection and this is why nickel-plating which is unaffected by ordinary atmospheric conditions is nothing more than a protective skin and if it is partially removed the exposed surface of the irons rust very readily. Copper-plating is no better, and if the iron is exposed the galvanic action is slightly unfavorable because the copper is in negative relation to the iron. Copper rolled over iron and then drawn, forms a good protection, but in this case the iron is nothing but a core. Lead would be a good coating metal if it were only harder and more readily attacked by acids.

Apart From Any Outside Agents.

The fourth and last case is that of metals in contact without any exterior agents being taken into account. Careful investigation has shown conclusively that if two metals are placed in close contact there will be a slow exchange of molecules, which will result in the metals alloying at their surface. If great pressure is applied during this exchange, the metals may be actually welded together. This action does not take place in a minute, nor even in a day or a month. It is very wonderful what pressure will do; certain salts in a finely powdered state

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have been compressed beyond a critical point where the cohesion became equal to that of the substance before it was pulverized and even transparency was recovered. What enormous power must exist within the atom to bring about the same results by rapid and unimpressive reaction; such as the recovery of crystals by dissolving a pulverized substance and then evaporating it.

This exchange of molecules between metals in contact is a simple case of diffusion. The diffusion of metals takes a great deal longer than that of liquids or gases because the internal friction is vastly greater; if the molecular cohesion is reduced by fusing the metals, the alloying will take place as readily as when whisky and water are mixed to form the alloy, which is known as a "high-ball." If the metals could be brought to a state of vapor, the diffusion would be practically instantaneous, and even if only one of the metals were in a state of vapor this should hasten the process to a considerable extent. I must ask you to take good note of this statement, because it has a very important bearing on the process and nature of dry galvanizing.

The effect of pressure is to hasten the action, but diffusion will always take place between metals provided there is some kind of contact. According to this theory the metals of alloys should become more thoroughly incorporated with time, and a zinc coating which has passed through the early stages of its existence without being destroyed should, like wine and love, improve with age; the two metals should gradually become alloyed at their surface of separation. If the old Ninivites or Egyptians had produced galvanized work there would be people to worry over the lost art of alloying iron and zinc just as others still persist in claiming that some useless art of hardening brass has been lost, although it has not even been proved as yet that it ever existed.

Specifications For an Ideal Coating.

On looking back at the four cases of metals in contact which I have discussed, you will readily see that all are closely related and that they must in all normal cases be present at one and the same time. What then are the specifications for an ideal metallic coating for iron?

First—It must be as far as possible from iron towards the positive end of the electromotive series and must fulfill the same requirements in the thermo-electric series.

Second—It must be affected by the same agents which corrode the iron.

Third—It must present as large a surface as possible to the corroding agents.

Fourth—It must be in very close contact with the iron.

Zinc is, of all the commercial metals, the one which most closely fulfills the first and second requirements; the third and fourth in regard to surface exposed and contact with the iron, are matters of process, and I shall, therefore, now proceed to describe the various processes which have been used to apply zinc to metal surfaces, but before doing so I want to point out that all these principles which I have enumerated apply as well to the salts of the metals and that is undoubtedly one reason why red lead and zinc white give such good protection against corrosion.

Cold Galvanizing.

In the early years of the last century the process of electrolytic zincing, which is nowdays known as cold or electro-galvanizing, was first discovered, but until about 10 years ago the lack of suitable equipment prevented its commercial application. The articles to be treated by this process are first thoroughly cleaned of scale, rust and grease by an acid pickle, sand-blasting, hot lye or by other means, singly or in combination, and are then placed as cathodes in a solution of some salt of zinc—usually the sulphate—in presence of zinc and which regenerate the solution, while a current of low voltage is passed through the arrangement and deposits zinc from the solution upon the articles. Numerous factors must be taken into account; the composition and temperature of the bath; the voltage and density of the current; the quality, shape and position of the anodes, and many other points which are all of prime importance if the results are to escape first criticism and then corrosion.

The surface of an electrically galvanized article is matt or frosted, provided

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the work has been properly done. It always shows a few pores. If improperly done, or if the work was not perfectly clean before treatment it is either honeycombed with pin holes or spongy. Above a certain limit of thickness, below which the coating is worthless, first class electro-galvanizing is superior to hot-galvanizing and it is cheaper to produce where automatic machinery can be employed, although less zinc is deposited than by a hot dip. This is no doubt due to the better contact between the zinc and iron.

Hot Galvanizing.

Sixty years ago the process of hot-galvanizing was introduced on a commercial scale. It consists in dipping the articles into a bath of molten spelter, with or without other metallic additions, at temperatures ranging from 750 to 900 degrees Fahr. The articles must be first cleaned as for electrolytic work, but a slight falling short of perfection does not have such disastrous effects on the quality of the result. Very heavy pieces may be heated before dipping so as not to chill the bath. The coating is crystalline or amorphous and does not adhere as perfectly as does the electrolytic one. Properly treated sheet metal goods have an attractive spangled appearance but most articles look like castings and sharp edges are lost. Metallic chlorides are used as fluxes, they are expected to remove the injurious salts of iron left by the pickling, but it is a question if it is not another case like the introduction of rabbits in Australia, and if they themselves are not the main cause of the decay which starts underneath the coating in hot-galvanizing work.*

Dry Galvanizing.

The latest process for applying a zinc coating, is the dry process, and I am going to endeavor, not only to describe the process itself, but to show you also how it fulfills the requirements which I have indicated, how it permits the extension of galvanizing to articles which have never been protected in this manner and how by divulging the mystery of the nature of zinc dust it permits us to speculate along new lines in metallurgy which may lead to the discovery of some principles of great industrial value.

The process of dry galvanizing or Sherardizing metals was awarded a gold medal at the St. Louis exposition of 1904 and the president's gold medal for 1905 was presented to its discoverer by the British Society of Engineers. The inventor, Sherard Cowper-Coles, is one of the most eminent metallurgical engineers in Europe and is well known for his reintroduction on a commercial scale of the process of electric galvanizing, the regenerating of electrolytes by the coke and zinc dust filter, the electrolytic spinning of copper into sheets, wire and other forms, and innumerable other inventions and improvements in connection with the electro-deposition of metals.

The Practice of Dry Galvanizing.

For the purpose of Sherardizing, the articles are placed, after cleaning, in a retort—usually a drum—and are covered with zinc dust, which is commonly called blue-powder, and is the flue-dust, and, therefore, a by-product of the zinc smelting furnace known as the Belgian furnace. It contains as a rule from 75 to 90 per cent of pure zinc; the supply of zinc-dust is ample at a price below that of spelter, and if the demand increases it can be produced in any quantity that may be required. A small amount of powdered charcoal is added to prevent oxidation of the zinc by the air inside the retort at the beginning of the operation, and the receptacle is closed and heated to a temperature about two hundred degrees below the melting point of zinc. Ideal conditions would obtain if the air were exhausted from the drums. Where the size of the plant warrants the control of the zinc-dust consumption to within so fine a margin, the drums might be filled with some inert gas such as carbonic dioxide which is supplied to soda fountains and other uses in steel bottles at a very low cost. It is, however, to be feared that if the temperature is allowed to go too high the carbonic dioxide might act as an oxidizer on some of the dust.

By Sherardizing, a homogeneous deposit of zinc is obtained, varying in thickness according to the length of time the

* The fumes given off in hot work are injurious to machinery and in a manufacturing concern it is necessary to erect a separate building for this work.

article is allowed to remain in the retort, its lower portion being an alloy of zinc and iron or of zinc and copper, as the case may be. In the case of copper the alloy is a true and hard brass. The drum is occasionally turned a fraction of a revolution to insure an even coating where the articles are crowded together, and the heating may last from a few minutes to several hours and two or three drums can be used in connection with one furnace.

A Sherardized surface resembles in general appearance an electrically coated surface. It is, however, of a soft silver-gray, more lustrous and metallic and, on that account, it is to most people, more pleasing to the eye, and it is distributed with great uniformity, which is not the case in hot galvanizing. Whereas in hot galvanizing the amount of zinc which is alloyed to the metal of the article is very small and most of the coating forms an exterior perishable skin, in Sherardizing the coating is thoroughly incorporated with the metal which it protects, forming an alloy having the appearance of pure zinc but much harder and more durable. It is on account of this thorough alloying that the protection afforded by Sherardizing is so superior to that afforded by either hot or electric galvanizing. The zinc having penetrated the iron, the old surface cannot be recovered by either chemical or mechanical means.

If an excessive amount of zinc is deposited by Sherardizing, the outside surface is composed of zinc somewhat hardened by the presence of a small percentage iron, and zinc-dust accumulates and clusters in a way which renders the surface rougher and much less attractive in appearance under magnification than it is to the naked eye. No special advantage is derived from the additional expense unless the conditions under which the articles are to be used are exceptionally severe.

The process of Sherardizing is not confined to zincing; the dusts of antimony and of other metals can be used in a similar manner. The fact that zinc-dust, even at temperatures higher than its melting point, does not melt or cake, is of great value in Sherardizing, as it eliminates the danger of spoilt work from carelessness in handling the temperature. Furthermore, zinc-dust containing as little as 35 per cent of pure metal can be used. The presence of the oxide is probably necessary, as it seems to play a part in the process.

Some Anomalies of the Process.

But why is it that zinc-dust acts in this peculiar manner, depositing zinc at a temperature several hundred degrees below its melting point, and why is it that the comparatively cold zinc alloys itself to the iron or other metal when the molten zinc of the hot process fails to do so, or at best only does so in a cumbrous limited way? I can only answer these questions by giving you my own theory of the nature of zinc dust and of its action under the conditions of Sherardizing. This theory is quite new to the very best of my knowledge and was not published by me until quite recently;* it is founded on observed facts but is not entirely empirical, because so far it has seemed to satisfy all the theoretical tests to which I have been able to put it and it answers a number of unexplained phenomena which I shall mention later.

The Nature of Zinc-Dust.

The vapor of zinc which is given off at a temperature of 1,000 degrees Cent., or more, at the inception of distillation, comes into contact with the comparatively cold atmosphere of the flue, the sudden chill causes a rapid condensation of the vapor, so rapid indeed that it skips the liquid stage and drops in the shape of perfectly spherical particles of which about 30,000 million can be crowded into a cube measuring one-sixteenth of an inch in every direction. This impalpable powder which, notwithstanding its high specific gravity—for it is only about 10 per cent lighter than zinc—can be blown about like lycopodium, is used mostly by paint manufacturers and is sold packed in barrels holding about 1,500 pounds. It is 10 or 15 per cent cheaper than virgin spelter at equal content of free zinc. It cannot be melted into slabs on account of its rapid oxidation at a very low temperature.

The peculiar properties of zinc-dust

*Electro Chemical and Metallurgical Industry, May, 1907.

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have been ascribed by some to the presence of cadmium, which being a more volatile metal is distilled first from the ore and condensed in the flues; one observer found quantities ranging from 0.283 to 0.794 per cent in flue dust after two hours of furnace operation. Others have claimed that these properties are due to the presence of zinc oxide or other impurities. No plausible reasons for these theories have as yet been advanced.

Most of the zinc-dust is produced in Belgium or in Silesia, and a sample which I have had analyzed showed the following composition:

Metallic zinc	88.95
Zinc oxide	6.88
Lead	3.45
Cadmium	0.62
Sulphur	0.55
Iron	0.04

G. Williams, an English chemist,* has shown that zinc-dust takes up water and decomposes it and gives up its hydrogen on heating; he has also shown that it absorbs hydrogen at ordinary temperatures when surrounded by it in a moist condition, and that heated alone it yields 50 times its volume of hydrogen, but when heated to redness with an equal weight of zinc hydroxide it gives off 535 times its volume of hydrogen. All this may have some bearing on the antics of zinc-dust and on Sherardizing, but as I am about to show it is unlikely and lacks confirmation, both theoretical and practical.

It is my belief that these impurities have little or nothing to do with the properties of zinc-dust and that the reasons should be sought for in its mode of production.

If under similar conditions of rapid cooling we produce other solid bodies we get unstable and brittle results. If a bead of fused glass is dropped into water a "Ruperts' tear" is the result. As you know, a Ruperts' tear is very unstable and whereas for a drop of normal glass of similar dimensions several good strokes of the hammer would be required to pulverize it, the Ruperts' drop can be shivered to fragments by breaking off its tail with two fingers, or by scratching the surface film where tension keeps the drop together. The difference of energy required to effect the destruction of the normal drop and the Ruperts' drop is enormous.

If we assume that zinc-dust is in this critical state we can explain almost every one of the effects which have puzzled chemists during the past forty years. Douglas Carnegie* found that zinc-dust *instantly* reduced ferric to ferrous salt, *and this even in neutral solutions* (the italics are his); this action he states was considerably quicker than with granulated zinc in the presence of sulphuric acid. He was at first inclined to ascribe this wonderful efficiency to the occluded hydrogen mentioned by Williams, but further experiments, which I need not detail, showed that he was mistaken. Referring to another chemical operation in which zinc-dust acted with equal promptness, he writes: "Zinc-dust merely effects instaneously the dechlorination which I found zinc foil required several hours to effect."

It is so well known that zinc-dust has a great affinity for oxygen at a low temperature that it has been used for a long time in the discharge style of printing of cotton goods. The fabric is first dyed a plain color and it is then printed on with a discharge paste. The zinc dust acts as a reducing agent at the temperature of the boiling water in which the cloth is dipped to effect the discharge.

A fact that is undoubtedly responsible in a great measure for the mystery attaching to the action of zinc-dust is its readiness to oxidize. It is only when oxidation is put out of its power, as in the closed Sherardizing drum, that heat will produce sufficient overstrain to cause the particles to burst into vapor. This vapor so suddenly released will condense instantly on the coolest spaces it can find. In Sherardizing the coolest spaces are on the articles in the

* *Chemical News*, Vol. 52.

* *Trans. Chem. Soc.*, London, yr. 1888, p. 468.

drum, and the drum itself being always hotter does not receive any deposit. One drum has already lasted two years without being coated. Zinc-dust appears to break down into vapor at about 150 to 200 degrees Cent., although it undoubtedly begins to disintegrate at a lower heat; as the pressure increases it takes a greater amount of heat to cause the breakdown; as the vapor condenses the pressure is relieved and the hotter particles of dust are vaporized and re-establish an equilibrium. In reference to this question of the vaporization of zinc, it is a well-known fact that zinc will at ordinary temperatures affect a photographic plate. This has always been ascribed to zinc vapor which exhibits in that state great chemical activity. Radiology, the new science, is expected to bear the burden of all such actions and I suppose I ought to say that the action of zinc on photographic plates is due to the slow disintegration of its atoms into energy and helium.

In a small way it is a significant fact that zinc-dust is intensely exothermic in its reactions, which means that these reactions are accompanied by the production of heat. I could also mention the property first pointed out by Schwarz, which zinc-dust has of combining violently with sulphur by percussion.

It has been known for some time that a cement made out of certain oils and zinc-dust possesses the useful property of becoming exceedingly firm and adhering closely to iron, steel and other metals, when heated to a temperature of 150 degrees Cent., or even less, if treated for a sufficient length of time. The theory of the nature of zinc-dust which I have given explains this hardening by the release of the zinc from its peculiar condition to form a solid without the formality of passing through the liquid stage. In the body of the cement it is protected from oxidation and the zinc becomes mechanically continuous. It is an excellent composition for calking cracks and crevices in metallic objects, for packing joints and for smoothing off the surface of castings.

I think that I have given you a sufficient number of examples to show that zinc-dust is a substance in a very abnormal physical condition and if I have spent so much time in doing so, it is because I feel certain that by taking advantage of this abnormal condition the metallurgical industries will before long reap important benefits.

Zinc Vapor and Ferro-Zinc.

I must tell you more about zinc vapor. This vapor is a gas just like air or any other gas and subject to the same physical laws, but as it is produced by the breakdown of zinc-dust particles at a very moderate temperature, it finds itself in the gaseous state at a point below its critical temperature and it will therefore readily assume the solid state by condensation under its own pressure, confined as it is within a retort.

When iron is pickled, hydrogen is given off on the surface and rises to the top of the vat. The pickle works its way into the metal and hydrogen is given off below the surface and remains occluded. This occlusion has very surprising results; the surface of the iron is hardened and if it is to be drawn through a die or worked in any way, it is necessary to bake out the gas. Hydrogen has been long suspected of metallic proclivities; it is often classed as a metal. It is known to form an alloy with palladium and it is supposed to alloy itself to the iron to produce the hard skin of which I have spoken. Zinc vapor acts in the same way in Sherardizing, but it forms an alloy all the more readily because in its normal condition it is itself a metal as we generally understand that rather arbitrary term.

Being a gas, the zinc vapor can force itself into the pores of the metal and form a deposit to a depth which will increase with the duration of the treatment. A small piece

can be alloyed throughout. An alloy of zinc and iron produced by fusion would be a sorry article when it came to be tested; "zinc-eisen," as it is called, is zinc ruined by the addition of a quantity of iron, which renders it brittle and worthless. By alloying with vapor at a low temperature the qualities of the metal cannot be injured, but they may be greatly improved by the zinc forming an intermolecular binding, which fills spaces which would otherwise allow motions of the particles under stress which might injure their cohesion; the vapor deposit should increase toughness and it is quite possible that this theory may have some bearing upon the general subject of the nature of alloys.

By using carbon as a condenser for free zinc vapor, out of contact with the dust, I have obtained a perfect zinc dew. I used a common arc lamp carbon and the drops on the top were large and reduced in size down to microscopical proportions on the edges. Here and there on the inside were traces of zinc, showing that the gas had penetrated the mass. The zinc vapor had not alloyed to the carbon, the specific heats being wide apart, whereas I have observed that the closer the specific heats of the zinc and the material to be coated at their working temperatures, the more quickly and firmly would they combine. It is no doubt on this account that copper Sherardizes so much more rapidly than does iron.

Improvements in Sherardizing will undoubtedly be founded on the intelligent control of the temperature, but to this end temperature readings will have to be taken inside the retort and not in the furnace as heretofore.

Working with gas alone and under the special conditions necessitated by the peculiar circumstances of the experiments, I was able to obtain quite a variety of deposits. Rapid cooling will cause the zinc to condense as crystals the adherence of which to the iron is, however, inversely proportional to their size. Normal cooling would seem to yield in all cases a fine glossy surface of what can be appropriately termed ferro-zinc.

Examining this ferro-zinc under about 400 diameters of enlargement it exhibits the structure of the original metal. A piece of mild steel which had been thoroughly pickled and which had been treated by vapor only, and was, therefore, free from any exterior zinc coating, such as would have concealed the alloy if operated on in contact with the dust, exhibited the usual structure of an etched mild steel. This ferro-zinc appears to be harder than the original iron and its rust-proof qualities are the true secret of the exceptional efficiency of Sherardizing.

The Creece test with sulphate of copper is not a fair test for Sherardizing, it is almost without significance for the following reasons: The outer coating of the slightly oxidized zinc particles resists the text better than does the brighter hot coating or the porous electrolytic one, but the alloy, obtained by vapor treatment alone, and which is present in all Sherardizing, readily takes the copper just as the iron itself would, and yet it will resist corrosion perfectly. The copper will deposit without destroying the zinc and the test is, therefore, worthless. The only way to test Sherardizing is to put it into service.

The alloy known as nickel steel does not rust easily and yet in a nickel plated article if the nickeling is partly removed the iron will be corroded. This shows that we must not expect contact theories to adapt themselves to perfection to metals in solution, and to alloys. The alloy of nickel and iron resists corrosion and in my opinion it is a parallel case to that of ferro-zinc.

The Romans to make their brass, which they called "Orichalcum," threw cadmia, (oxide of zinc) on highly heated copper. The more recent calamine brass process which was in use until about one hundred years ago, consisted in heating calamine (zinc silicate), granulated copper and coke—dust in crucibles, the fusion and alloying taking place at a temperature con-

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siderably lower than the melting point of copper. I thought these two points of history might interest you by comparison and as aids to the digestion of the most recent developments.

The Theory of Dry Galvanizing.

Let us enter the Sherardizing retort and endeavor to find out what takes place. Which guess will offer the most plausible explanation? It is an established fact that in Sherardizing the presence of zinc oxide is necessary. We might suppose, therefore, that a molecule of oxide is reduced by voltaic action when it comes into contact with the iron; the zinc attaches itself to the iron which acts therefore, as a cathode in electrolysis, and the oxygen travels in the opposite direction, combines with a free molecule of zinc to form a molecule of oxide, and goes through the same performance as before.

I have excellent reasons, which I must keep for later publication, for believing that this hypothesis is pretty close to the truth if not the true explanation of the action in dry galvanizing.

The outer coating is composed of reduced zinc in granular form and the silver gray appearance may be due to slight oxidation of the surface.

Whatever the true explanation may be it is of little immediate interest to "practical" men, but it is of great interest to scientists who are expected to continue furnishing their abstract facts to serve as souls to the concrete bodies created by inventors. The inventors, while claiming all the credit, usually sell or lose most of it to men who put these inventions into practical use. He laughs best who laughs last, and by the time the invention has become an industry the poor scientist has been entirely forgotten,—except to be occasionally dubbed a theorician, a dreamer, a simple soul, a mild and childlike,—for of such is the kingdom of heaven.

The Efficiency of Dry Galvanizing.

The efficiency of dry galvanizing, which has been proved by thorough testing both in England and Germany, is due to its fulfilling the conditions which I have set forth in the early part of this paper.

Considered merely as a covering, it fits as closely as does an electrically deposited coating and it is impenetrable because free from pores or cracks.

As a mechanical protection it resists both abrasion and impact better than hot or cold work because of the qualities of the ferro-zinc alloy. Zinc itself is superior to both tin and lead in ductility and tenacity.

Considered in relation to contact effects the zinc distilled as vapor and alloyed to the iron is absolutely pure and the span between it and the iron in the electromotive series is, therefore, extended as compared with a zinc containing a percentage of impurities. Its contact with the iron in the body of the alloy is as perfect as is possible. In relation to corroding agents its granular structure offers a maximum surface for them to decompose and, therefore, increases the ratio in which the coating acts by its own decomposition as a protection to the iron.

Commercial Scope of Dry Galvanizing.

It is a noteworthy fact that while many articles have appeared in technical and scientific journals about Sherardizing, not one word of criticism or denial of its claims has as yet been offered. I have been looking for serious criticism for some time past but when I have found doubters I have only succeeded in making new converts. The process has always appealed to scientific men because they are in position to appreciate the solid scientific foundations of its claims.

The new process has not entered the field as a competitor to galvanizing alone; in a great many instances it can take the place of coppering, of nickel-plating and of tinning, where the articles are not to be used for the preparation or handling of foodstuffs. To these I should add the large amount of copper and brass articles, from tubing to typewriter and sewing machine parts which are now nickel-plated. An interesting point in rela-

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tion to the various methods of protecting metals is the price of the metals themselves. Nickel is 7¾ times, tin and aluminum 7 times, copper 4⅛ times and antimony 3¼ times as high in price as spelter, and at equal efficiency against corrosion the lightest coating is one of zinc as applied by dry-galvanizing.

Analyzing the various items which go to make up the cost of Sherardizing, we find that in every instance there is a saving either over the hot process or over the electric process. In most cases the saving is over both of the older processes.

Initial Expense.

A plant for Sherardizing is less expensive than a hot plant and very much less so than an electric plant. Every part of it is of a simple nature and calls for neither feat of engineering nor for the solution of any out-of-the-way problems. It is very much like a plant for close annealing, and whereas the depreciation on a hot plant is usually taken at 50 per cent per annum, the depreciation on a Sherardizing plant would not exceed 10 per cent, which is the depreciation commonly figured on an electrolytic plant. The drums are not made of perishable hard rubber or wood as are those for electrolytic galvanizing. The process can be carried on in the main manufacturing building, and the pickling done in the cheapest kind of an outhouse.

The Saving in Cost of Zinc.

For an equal thickness of coating, the zinc actually deposited is about the same in value whether derived from dust or from spelter slabs. It is less than the anodes used in electrolytic work which have to be cast specially and are very often of odd or complicated form. Even less zinc is required than in the electric process because an equal thickness is more effective and because the distribution is fully as even. In Sheradizing there is nothing to throw away, but sufficient dust (from 1 to 5 per cent) is added from time to time to replace that of the weight of the articles coated which has been used. There is no equivalent to the unsatisfactory results due to using spelter recovered from dross and therefore contaminated by the presence of iron.

In electro-deposition an unobstructed path is required between the anode and the object, for the dissociated ions of the salts in solution to travel. If any part is hidden or recessed no deposit is made and the parts furthest from the anodes have the lightest coating. In addition to this it must be understood that the anodes are not entirely used up and part of them is lost at the bottom of the tank, and as eaten-out remnants they cannot be used to the vanishing point.

It is hardly necessary to point out the enormous saving in the quantity of zinc used as compared with the hot process. Hot galvanized articles have, as a rule, a much thicker coating than is necessary because most of them cannot be conveniently wiped like wire or band iron. In Sherardizing all the zinc is consumed and the thickness of deposit is regulated just as readily as in the electric process. In the hot process a large percentage of spelter is converted into dross and skimmings, and while much of it is recovered, the net loss cuts quite a figure on the cost sheet.

The Saving in Labor.

Sherardizing is like annealing in that it requires but a small amount of labor, and that unskilled, placed under proper superintendence. A drum holding one or more tons of articles can be left to itself for half an hour or more subject to an occasional turn; in the meantime another drum is being prepared for Sherardizing while the first will be cooling. Suitable partitions will allow of several classes of small articles being Sherardized in one drum without mixing.

Hot galvanizing requires constant attention and handling, which can seldom be done by one man even with the aid of overhead trolleys and similar fixtures. It is not a mechanical or automatic process, but one of hard manual labor, and the regulation of

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temperature and methods of dipping require the attention of an experienced galvanizer.

As a leading authority on hot work has written: "Considerable skill is required to bring a piece of work out of the metal and cool it so that the surface will be smooth, free from blisters and with no lumps of surplus metal attached."

For the electric process at least one man possessing some knowledge of electricity and of all the whims of electrolytics is needed. In electro-deposition irregular shapes—excepting in the case of very small articles—require regular shaped anodes, but in Sherardizing the dust, every particle of which may be considered as a minute anode in itself, is used just as it comes from the refiners for any size or shape of article.

By combining the advantages of both the old processes, Sherardizing enables a manufacturer to galvanize with one plant only, articles which have hitherto been divided between the two processes, the small ones being electro-galvanized and the large ones dipped. Less care is needed in cleaning the articles to be Sherardized, and oil or grease, far from being objectionable, are helpful to the process, because their volatile hydrocarbons help to prevent oxidation of the dust; the addition of grease or vaseline has indeed been found to be of some advantage in many cases. Furthermore, the articles can be put into the drums wet, as they come from the washing tank. The labor of recutting threads is eliminated. Bolts, screws and nuts can be put in the drum just as they are delivered from the machines, covered with oil or cutting compound.

With small installations the process can be worked intermittently. The low cost of the plant warrants a manufacturer in running a drum two or three days a week instead of sending his work out, thereby saving time, freight and jobbers' profits. The temperature required is so low that it takes very little time to start the furnace and where gas is used this element of time may be almost disregarded. This low temperature also suggests using the waste gases of annealing and other furnaces, and in many cases it will be found economical to place a whole day's production in the retort and leave it in overnight with the night watchman to keep his eye on the pyrometer. There is no labor for skimming and drossing; no pots to scrape at unexpected times, nor furnaces to destroy and rebuild at all too frequent intervals.

The Saving in Fuel and Power.

The plainest fact about hot galvanizing is its thermal inefficiency. The pot must be kept going day and night, whether in use or not, and even during its operation most of the heat is lost by radiation and by having to bring the articles to the temperature of the bath. On the other hand, power is seldom an item of any consequence, whereas in electrolytic work the amount of current consumed is quite large, for a deposit which is meant for something more than exhibition purposes or to be buried out of sight and forgotten. This is seldom appreciated because electricity is unobtrusive in its action; the cost of electro-galvanizing thin sheets is prohibitive on account of the amount of current consumed. In Sherardizing the heat is very low and is kept in by a lining of refractory material; the articles do not have to reach the temperature of the zinc dust and the apparatus is always ready for work on short notice. The temperature does not have to be varied to suit the different sizes and classes of articles to be coated and as I have suggested, waste gases can be used under many circumstances.

Other Factors of Economy.

With the new process, less acid is used than in the electrolytic process because the cleaning does not have to be so thorough. The vapor works its way under specks of dirt and bare spots cannot exist. No flux of any kind is needed as in hot galvanizing, and there are no comparatively high-priced electrical supplies to be bought.

There is no danger whatever from

explosions, no broken castings nor distorted iron work to replace, and the temper of the finest steel blades and of steel springs is in no way injured by the low temperature used. This may at first seem strange and will not be perfectly clear until we know something more about the temperatures existing and the reactions taking place in the retort.

Various Applications of Dry Galvanizing.

Sherardizing will not full an uncalked seam and act as a solder, this is its one limitation but it has a great variety of new applications to make up for it. Fly screening can be galvanized and the business parts of agricultural implements such as mower and harrow teeth can receive adequate protection at a low cost without impairing their qualities.

Flashing a surface electrically to discover flaws has been in use for some years and Sherardizing will render the same service; it is, in fact, being used at the present time for this very purpose for boiler tubes. However, while electric flashing is worthless against corrosion, a flashing with zinc dust or vapor is very effective as a rust preventive, and of particular service for articles which are to be shipped across the ocean.

Within reasonable limits innumerable machined articles, tools, locomotive and engine parts can be flashed with zinc and be effectively protected against rust under the conditions of their operation, whereas at present they must be periodically cleaned at the expense of their appearance and of the accuracy of their fit. Articles such as wire, tubes, etc., either flashed or coated with a heavy deposit can be drawn out, the coating drawing out with the material itself.

A brilliant and permanent polish which can hardly be distinguished from nickel-plating, but bluer and more like silver, and a better reflector of light, can be given to Sherardized articles by means of the usual burnishing tools and machines, but unlike nickel-plating it is absolutely rust-proof. This polish is not temporary like that of electro-galvanizing, and it is hard and durable if worked down, as it should be, to the ferro-zinc. The reason that it does not whiten by corrosion, as might naturally be expected, is because the surface has flowed to an inpervious film and the iron is shielded from any contact effects. In this connection it should be remembered that highly polished steel is relatively rust-proof. If, however, nickel-plating is preferred a light Sherardizing before plating, instead of coppering, will ensure very thorough adherence of the nickel to the ferro-zinc and superior rust-proof qualities will be obtained. It has been shown that it is very difficult to volatilize zinc from alloys where there is any nickel present.*

Sherardized aluminum can be electro-plated and the objectionable soft surface be overcome, not to mention the finish and appearance.

Sherardizing has been found to protect silver from sulphated hydrogen which blackens it; it can be applied very lightly before polishing without altering the color. When aluminum has been Sherardized it can be readily soldered; this is expected to do away with the very unsatisfactory riveting of articles made from aluminum sheets. The latest application is for inlaying or damascening and this art is being carried out in England on a commercial scale. A variety of colors can be obtained by using different dusts and by varying the time, thereby obtaining alloys of different tints. The designs shade off in a pleasing manner beyond the edges of the stopping-off material which acts as a stencil in setting graphical limits to the action of the dusts and vapors.

It is very seldom that in the history of invention we find an improved process which corrects so many defects, removes so many limitations of the processes in use and creates so many new and novel applications as does dry-galvanizing.

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* See A. R. Haslam in *Chem. News*, Vol. 51.

SCIENCE APPLIED TO THE BRASS INDUSTRY

By Andrew M. Fairlie, Copper Hill, Tenn.

For the sake of progress in the brass industry, as well as for the advancement of science, it is highly desirable that the brass and scientific men learn to know each other better. Science is not nearly so formidable as many believe. She should be respected, it is true, but not treated with awe; for the benefits she has bestowed, she should be admired, not feared and shunned; and while she continues to promise aid, economically lightening the labors of men, improving the quality of products and the efficiency of processes, she should be cherished, not ignored, maligned not abused.

Science, it must be admitted, is a forbidding word. Yet it need not be. As indicated by its derivation, science is nothing more nor less terrible than knowledge. More specifically, it is the knowledge of nature's laws. An incident that occurred in the course of this day's work will illustrate at once the meaning of science, and its value to the brass industry. Mr. X. was superintending the manufacture of a new metal, an alloy of nickel and lead. He weighed the metals himself, and was particular that the percentages should remain exactly as planned. He was out of the foundry when the lead was added, but stepped in just as the men were skimming, and as he did so, saw a heavy lump fall from the crucible to the floor.

"What's that?" asked X, suspiciously.

"Slag from the coke," was the reply, and this statement was corroborated by a fellow workman.

Not content, X plunged the lump into water to cool it, scratched the surface with a file, and saw that the lump was not slag, but metal. Application of the magnet indicated that the metal was either nickel or iron, and a simple chemical test excluded the latter, so that the deduction was plain. The men chilled the nickel by adding the lead too fast, then skimmed off the frozen nickel, which had come to the surface of the lead, and so, entirely ignorant of this fact, spoiled their work. In this case only very elementary science, or knowledge, if you will, was required to detect the error and apply the remedy—a new casting.

Contemplating the help that science has already given the brass maker, analytical chemistry at once claims our attention. This branch of chemistry detects injurious impurities in the commercial metals from which brass is made; it locates and measures the losses in the business; by pointing out the sources of inaccuracy, it standardizes the mixtures of a casting shop; it shows the exact composition of any metal submitted for reproduction; by selecting the good and bad qualities of molding sands it improves the quality of sand castings; it distinguishes good coal and coke from poor, and in many ways discovers the cause of trouble.

Metallurgy, in its turn, has been of service. The methods of recovering metal from scrap have been improved. The cause of porosity in castings has been found, and the soundest castings are now possible by the use of deoxidizers, such as silicon, phosphorus, aluminum or magnesium. The oxidation of metals in the foundry has been diminished by keeping the molten metal surrounded as much as possible by reducing gases, both while melting and while pouring. The pernicious effect of the iron stirrer for mixing alloys has been demonstrated, and one of graphite substituted.

Physics has furnished the conductivity bridge and the pyrometer. Since extremely small proportions of certain impurities in copper have a powerful

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effect in depressing the electrical conductivity, the former has been adopted as a quick and accurate means of testing the purity of refined copper. The pyrometer, by controlling the temperature, tends to render furnace processes more exact. The microscope, extending its researches to the examination of the non-ferrous metals, has been directed upon polished and etched sections, of copper, brass and bronze, and has revealed the varying structures resulting from different degrees of heat in melting and pouring, as well as from forging, rolling, and other mechanical processes.

In the electro-plating industry the value of circulating the electrolite, either by rotating an electrode or otherwise, has been recognized and the principle applied.

But it is not possible, nor, indeed, is it necessary, to enumerate within the limits of an association paper all of the scientific discoveries and inventions adopted in practice by the brass industry since the days when, eighty years ago, sheet brass was made in Waterbury, Conn., by alternately passing the ingot between heavy steel rolls and annealing in the flames of a chestnut wood fire. So much for the past and present—what is the outlook for the future? Completeness applied to the future is, of course, out of the question, and one must be content with a study of the signs of the times. Even thus the limitations of time and space serve an injunction against completeness, and we can consider here only a few of the problems which confront this generation.

We had in mind just now the electro-plating industry. The electro-plating shop needs the chemist and metallurgist more, perhaps, than any other branch of the non-ferrous metal industry. An examination of the inquiry columns of the trade papers demonstrates that rule-of-thumb methods in the plating room do not meet the requirements. The trouble experienced by the platers in controlling their solutions and costs and the quality of their work is simply evidence that the electro-plating shop ought to be, and must become an electro-chemical and metallurgical laboratory on a commercial scale; that the handful of this, the pinch of that, and the bucketful of the other—yes, even the dram and ounce and gallon—must give place to the gram and the liter; in short, that science must foster an industry that was born of science. It is too much to say that science is now prepared to solve off-hand any electro-plating problem that might be presented. Problems in practice require scientific investigation, and as electro-plating problems have been neglected, much painstaking work will be required for their solution. Let us see what probability of success is offered to stimulate efforts in this direction.

Ideally, the metal dissolved from an anode showed equal the metal deposited on the cathode, the bath remaining unchanged. Practically, this desideratum is today seldom achieved. Impurities in the anode dissolve in the bath, polluting it, and at the same time metal is deposited on the cathode more rapidly than it is dissolved from the anode. The excess is derived from the bath, with consequent variation in composition. Furthermore, certain impurities, insoluble in the electrolyte, either form a coating on the anode, partially insulating it, or, falling off, foul the bath; consequently the electrolyte has to be regenerated or renewed from time to time. Such obstacles should not be regarded as insurmountable. On the contrary, experience shows that patient application of scientific principles will overcome such difficulties. For example, several years ago Dr. N. S. Keith was confronted with a problem in the electrolytic refining of lead base bullion.* His solution of lead acetate and lead nitrate became decomposed, with the formation of insoluble salts which interfered with the deposition. The problem was finally solved by substituting for the original bath an electrolyte composed of lead sulphate dissolved in sodic acetate. Dr. Keith avers that the integrity of this

Electrical Industry, June, 1903, p. 345.

electrolyte was preserved indefinitely, that the salts gave no further trouble, and that equal amounts of lead were deposited at the cathode and dissolved from the anode. The extension of such studies as this to electro-plating is what the industry needs.

Prof. Burgess has described a process for the electrolytic stripping of brass from iron,† by means of which superfluous brass may be stripped from parts of bicycles, and automobiles, and other work which has been subjected to the brazing process. Silver can in the same way be recovered from old articles submitted for replating, and from suspension rods, hooks and baskets used in the process. Files clogged with brass, copper or lead may be cleaned by this means, and the coating of tin or tinned iron may be recovered. It remains for science to invent, and for the electro-plating industry to apply, a satisfactory electrolytic process for stripping nickel from iron. It is a significant fact those metals most amenable to the electro-plating process are metals which alloy readily and which are easily soldered together.

Hence the theory that both electro-plating and soldering depend upon the uniting of two metals on surface alloying at the point of contact. A new process of coating metals, viz., sherardizing (so called after its inventor, Sherard Cowper-Coles), has demonstrated, according to Alfred Sang,‡ that surface alloying is possible, and that, too, at comparatively low temperatures. Briefly, sherardizing consists in coating the surface of metals with zinc by means of zinc-dust, or "blue powder," a by-product of the zinc smelters.

Mr. Sang describes the process as follows: "The articles to be coated are placed in a cast iron drum and covered with commercial zinc-dust; the drum is closed tightly, and placed in an oven heated to a temperature of about 300 degrees Cent. The length of time during which the articles are exposed to the heat depends on the thickness of the deposit desired. At the end of the heating period the drum is allowed to cool, and the articles are taken out. Notwithstanding the fact that metallic zinc does not vaporize below 940 degrees Cent., the zinc-dust is found to vaporize at the low temperature mentioned, and, being at a higher pressure than the atmosphere of the oven, the zinc gas penetrates the metal to be coated, forming on iron articles a protective surface said to be superior to either hot or cold galvanizing."

Commenting on the characteristics of the coating, Mr. Sang says:

"There is no doubt about the combination of the zinc and the metal of the article being sufficiently intimate to be classed as an alloy. Copper which has been sherardized shows a skin of hard brass, and the blow-pipe is unable to form a bead of zinc on the surface of sherardized iron as it does when the iron has been hot or electrically coated. The longer the process is conducted the deeper will the vapor go into the metal."

It may be that enthusiasm for the new process has banished for a time the sober judgment of its investigators; but if even half of its claims can be justified, sherardizing has before it a field for operation unlimited in extent. If the process is commercially practicable, to what lengths will it eventually go? Successful in producing surface alloys at a low temperature, it is possible that our scientists may yet develop an economical process for the cold manufacture of brass.

Other problems of the foundry, more practical ones, and of greater interest to the manufacturer and the business man offer opportunities for the advancement of science and the progress of the metal industry. What, for example, do the brass melters know of the efficiency of their furnaces—that is, of the relations which the heat units utilized bear to the heat units contained in the fuel consumed? Are they aware that, given the proper data, such relations can be calculated, and that the information so obtained can be used as a basis for devising new and more efficient furnaces?

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†Chas. F. Burgess, "Electrolytic Stripping of Metals," *Electro-Chemical Industry*, January, 1904, p. 8.

‡"Theory and Practice of Sherardizing." *Electro-Chemical and Metallurgical Industry*, May, 1907, p. 187.

Prof. J. W. Richards, in section VI of his invaluable serial on Metallurgical Calculations* cites as a problem for solution the efficiency of a regenerative oil-burning furnace manufactured by the Rockwell Engineering Co. Lacking certain items of information necessary for the solution of this particular problem, he made assumptions (probably not far from the truth), to supply the missing data, and in this way calculated that the net efficiency of the furnace was only 14 per cent. It is reasonable to suppose that the wind furnace would prove far less efficient than even this low figure. In the same article Prof. Richards points out the deficiency of scientific data concerning alloys. To quote:

"There is here a wide and interesting field for metallurgical research, whose cultivation would yield results both of high practical and high theoretical interest, and yet it is comparatively untouched. What is wanted is complete data concerning the specific heat of solid and liquid alloy, and latent heat of fusion. These, combined with the determination of the heat evolved in the alloying, would furnish a sound basis for a practical theory of alloys, besides enabling workers with these alloys to control the efficiency of their furnaces, and, in general, to know with scientific exactness what they are accomplishing."

Besides the data mentioned by Prof. Richards there are opportunities for much valuable work along other lines—for example, with the pyrometer and the microscope, in determining the effect on alloys of different melting and pouring temperatures; the effect of variations in the rate of cooling; the effect of different heats in the annealing furnaces; and so on indefinitely.

At intervals during the past three years scientific men have been exploiting in the technical press a project which must be of great interest to the brass foundryman—the manufacture of non-ferrous alloys by electricity. Any brass melter will admit that the crucible method of making brass is by no means an ideal process, and he is willing to abandon it as soon as a better method is substituted. The average crucible holds about 200 pounds of metal. Handling brass in such small lots involves a heavy labor charge, and furthermore involves difficulty in controlling the quality of the alloy. Should a single slab of spelter contain a large amount of impurity, the whole of it is concentrated in the particular slab of brass cast. By the crucible method the losses of zinc by oxidation and volatilization are enormous, and not only is the quality of the brass often impaired by oxidation, but owing to the uncertainty as to the amount of zinc lost per heat, it becomes very difficult to cast a zinc alloy of the precise composition desired. The crucible furnaces are extremely wasteful of heat, their heat is hard to control, and to use them invites contamination of the metal with foreign matter. Finally, crucibles are costly and fragile. Useless after 35 or 40 heats, they are a heavy expense to the foundry, to say nothing of the value of the metal lost by an occasional accident.

On the other hand, note the advantages claimed for the electric furnace:

I.—Larger tonnage per heat. Results:
- A—Lower labor charge per ton.
- B—Dilution of impurities in distribution throughout large masses of metal.
- C—Homogeneity of product.

II.—Durability of furnace. Results:
- A—Elimination of breakage charge.

III.—Generation of heat within the metal. Results:
- A—Great heat efficiency of furnace.
- B—Accurate control of temperature to within 10 degrees Cent.
- C—Oxidizing atmosphere absent. Results:
  - 1—Elimination of zinc losses.
  - 2—Accurate mixture of known composition.
- D—Exclusion of foreign matter from mixtures.

The type of furnace recommended by those interested is that known as the induction furnace, the heat being generated within the mass of metals to be fused into an alloy. The success attained by the induction furnace in the steel industry speaks well for the practicability

* *Electro-chemical and Metallurgical Industry*, Aug. 1905, p. 300.

of applying it to the brass foundry. In February, 1905, the editor of a prominent technical journal predicted that the electric furnace would replace the crucible in the brass foundry within ten years. Only two have passed, and already the announcement has been made, that experiments to determine the feasibility of the project are under way.

The value of science to our industry has been merely hinted at; any one of the topics suggested could be enlarged upon so as to exceed this paper in volume, and more topics could be added. But these hints may suffice to win new advocates for science applied to the brass industry.

New advocates for science among the brass manufacturers—greater intimacy between science and art—is the first requirement for progress. Other conditions, already laid down* for the progress of another industry, yet applicable to our own, are: 1—Wider circulation of scientific and technical literature; 2—discovery of new facts in science useful to the industry; 3—clearer knowledge of the laws correlating these facts; 4—increasing application of science to industrial needs.

AUTOMATIC POLISHING

By Jonas A. Parker, Rochester, N. Y.

Attempts at automatic polishing, or buffing, extend back over a period of many years, but only during the past few years has it taken on a practical form and met with such popular favor as to assure its ultimate success, both as regards economy and improved health conditions. Mechanical polishing will continue to advance along with other metal working machinery just in proportion as it deserves. The finest machine shop equipment, manned and supervised as some buff-rooms now are, would produce results disappointing to a firm's manager, yet we do not attribute many past failures of mechanical polishing to the ignorance of the operatives alone.

Automatic polishing has been held back because of a crazy endeavor of inventors to construct a machine that would polish anything from a button to a cook stove. Patent attorneys have feasted, experimental machinists have benefited and the junk dealer has smiled as he has seen some dear creation relegated to the scrap heap. Experimenters at last changed their ideas and they built a machine to polish buttons and nothing else. The same in a measure is true of cook stoves and heaters.

After many discouragements and trials a machine is now manufactured and in use in many of the larger stove works in which you place castings similar in form and outline, and their polishing is rapidly accomplished. No attempt is made to polish all the parts on this one machine; other parts, the rings for instance, receive attention from a machine bearing no point of resemblance to the first machine. I am reliably informed by a large manufacturer of stoves that they simply could not complete their orders had they to depend on hand polishing. The same may be said of tubing used in gas ranges, bathrooms, chandelier fixtures and bedstead work.

Later automatic machines for polishing hollow-ware were called for and the call was not in vain. After experiments extending over a period of three years, machines are now operating in many large factories not only doing the work at a great saving in cost, but doing better work than can be obtained by hand buffing. Such in-

*By Prof. J. W. Richards.

roads have been made in the polishing field by mechanical polishing that in some instances hollow-ware factories have dispensed with one-half their former polishing force and have secured an increased output. Owing to similarity of sizes and shapes, hollow-ware has proven an advantageous field for automatic polishing and manufacturers have not been slow to avail themselves of the advantage afforded. Lamps, particularly those of the automobile variety, search lights and headlight reflectors are also included in this line.

Reliability.

Another point not to be lost sight of in an investigation of mechanical polishing is the reliability of the machine. They do not absent themselves from the factory as is sometimes the case of hand polishers, thus decreasing the output during a rush season. They serve as a reminder to their operator that they are there to do the work, and being simple of operation no time is lost owing to absence of regular operator, as another without skilled training can quickly operate them at their full capacity.

Ragged irregular shapes cannot be successfully polished by machines, but while waiting the coming of the electrician or chemist who shall by invention obliterate all remainder of the death-dealing buff wheel, is it not incumbent upon you as employers to investigate claims made for ameliorating this serious condition?

You ask if machine polishing can be adapted to your line of work and how it will benefit the polisher?

The answer is, first by releasing a large percentage of those now employed over the disease breeding buff wheels, and forcing them, if necessary, to other trades fit for man.

Second, in removing those who are needed to operate machines, away from the seat of trouble to a natural position. Improving the condition has improved the man and he leaves the factory after his day's work with the same feeling of satisfaction as the machinist or the office clerk.

In conclusion, then, I invite you to investigate automatic polishing. I believe it worthy of your encouragement both from a financial and a humanitarian standpoint.

COPPER FOR THE FOUNDRY

By F. L. Antisell, Perth Amboy, N. J.

Copper for foundry purposes is required to possess certain properties, determined by the specific use for which it is intended, and that particular grade should be selected which will fill the requirements of the work in hand. To this end, the buyer should carefully consider the following points:

(1) Brand.
(2) Conductivity.
(3) Analysis.
(4) Shape.
(5) Appearance, i. e., color, pitch, etc.

The brand, which the writer considers as first in importance, conveys the greatest amount of information to the buyer of copper. It insures uniform quality aside from the chemical analysis (as various brands of copper vary somewhat in pitch, or say if you like, gases or oxides), which fact is of great practical advantage to the mixer of copper alloys, as the melting can be conducted largely by a pre-arranged schedule, for a reliable brand of copper can always be depended upon to run uniform, whereas, while the unknown or unbranded ingot may represent the very best grade of copper obtainable. It, on the other hand, may be only capable of producing a casting

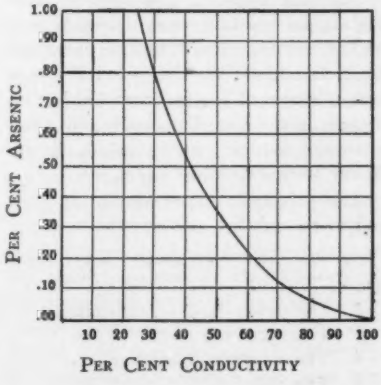
of inferior quality. Again, certain brands stand for a reputation that has required a vast amount of capital to create, and a large plant to produce. It is evident that a non-uniform brand of copper would jeopardize the business of the producing plant. To guard against this possibility, makers of various brands use every precaution to keep their products uniform in quality, it being not unusual to cast over 100,000 pounds of ingots at one charge, 12 ingots being cast simultaneously every 20 or 30 seconds. This large bath of copper is constantly under the inspection of metallurgists, chemists, and physical scientists. It can be said as an almost universal truth that writers on this subject invariably recommend the purchase of branded ingot copper only. However, with the advent of the foundry chemist, and with a good conductivity bridge, microscope and accessories, this situation will probably change to some degree in the future.

Conductivity.

Conductivity may be well considered second in importance only to the brand as it can be said within certain restrictions to be a measure of the ultimate quality of the metal. This test should be carefully conducted with an apparatus of modern design. For the foundryman the best results will be obtained by drawing into wire a specimen of the ingot and testing the hard drawn wire. The number of dies varies with the grade of copper. The same specimen can then be tested for tensile strength.

If the conductivity of hard drawn copper wire is 98.75 per cent (Mathiessen's standard), it will represent a conductivity of about 101 per cent if properly annealed. Should any impurities appear, the conductivity will be lower according to the specific resistance of the alloy, and quantity of various elements.

The accompanying illustration shows graphically how the occurrence of even the most minute quantity of arsenic will vary the conductivity of copper. Thus, in annealed copper wire with a conductivity of 100 per cent we would hardly expect to find more than a trace of arsenic. Curves for the different elements show in an interesting manner the effect of impurities in copper. However, high conductivity in itself does not prove conclusively that between two specimens the higher in conductivity is the more suitable for casting purposes. Within certain limits copper may contain impurities in an oxidized condition, thus reducing the resistance of the specimen as a copper alloy, but at the expense of its tensile strength whereas, on the other hand, the impurity occurring in a metallic state must necessarily reduce the conductivity, and in practically all cases increase the tensile strength. Thus the conductivity test



is of more importance when considered in connection with a tensile test, and though various investigators do not agree in general on the point, it appears that as the rate of conductivity increases, the tensile strength decreases. The specimen for this test must necessarily therefore be treated for ultimate tensile strength only.

While copper refiners always give attention to the proper de-oxidizing of the metal there is almost always present a small quantity of copper oxide that does not appear to decrease either its conductivity or tensile strength.

Analysis.

In buying copper on analysis it is generally sufficient to specify the total

copper contents. Copper running 99.90 per cent pure is suitable for the highest grade of copper alloy, and no distinction is necessary in specifying its origin as "Lake," "Electrolytic," etc. The percentage of copper contents may decrease steadily for different requirements according to the nature of the impurities. The principal impurities are arsenic, antimony, iron, sulphur, bismuth, selenium and tellurium.

Shape.

The shape of ingots varies with the individual tastes of refiners. In fact, it is not unusual for copper refiners producing two or more grades of ingots, to make them up into different shapes, thereby reducing the probability of mixing qualities. It would appear that a standard shape and weight of casting copper would be very desirable, and should receive some attention from the brass founder. The ingot has in many cases increased in thickness until its weight is close to 20 pounds, and often possesses but two heels, making it too heavy to be easily cut apart.

The principal shapes of casting copper in the market are:

1. The old fashioned three-heeled ingot.
2. The newer form of two-heeled.
3. The ingot bar.
4. The multiple ingot bar.
5. The slab.

These shapes all have advantages peculiar to themselves, but it would seem that the old fashioned ingot bar is more than holding its own, and is generally preferred by brass founders.

The ingot bar consists of a number of ingots cast continuously, end to end, generally in groups of three three-heeled ingots, the ends being joined by a thin gate, forming an extra deep notch to facilitate detaching the individual ingots.

The multiple ingot bar is formed by several ingot bars cast side by side and connected at several points by gates. These bars must necessarily be cut apart before melting, and when adequate facilities are not at hand to separate them, the final cost is somewhat greater than for the ingot weighing say 20 pounds, although the latter has probably to stand a charge for cooperage. Furthermore, the ingot bar when cut apart presents sharp corners that have a tendency to abrade and shorten the life of the crucible.

To get economical results from the slab, it is necessary to use a substantial shearing machine, capable of cutting the slab into pieces of proper size to be placed in the crucible, and the cost of this work must be charged against the shape as an offset to the saving in shipping expense.

Appearance.

If the author of the saying, "Appearances are deceiving," had in mind copper when making this remark, he could hardly have explained the situation more clearly. If there is one thing impossible, it is to judge the quality of copper by the color of its skin.

The terms, "rose red," "brassy," "black," mean nothing in regard to quality; the most beautiful rose colored ingot may contain one-half per cent of arsenic, while the blackest looking ingot ever made may be 99.99 fine. The various colors are due almost entirely to the temperature of the copper and pickle, when the casting leaves the mold. The pitch on the back of the ingot should be fairly flat with a uniform wrinkled top surface, and without sharp corners.

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ELECTRO-DEPOSITION OF BRASS

By Chas. H. Proctor, Arlington, N. J.

Not since the French Syndicate controlled the copper market of the world, more than 20 years ago, has copper reached such an intrinsic value as it has today. This is not due to any combination of labor or capital, but to natural results of supply and demand.

When we take into consideration the unprecedented demand for copper created by the vast changes that are taking place in the great motive power systems of this country—and we might just as well say of the civilized world—from steam to electricity, and the tremendous amount of copper consumed in these changes, it is not necessary to go very deeply into details to form an opinion as to why copper has reached the high price at which it now stands.

The high price of copper has had such an effect on the brass industry of the world that in many lines of manufacture, which have usually been made of brass or a similar alloy, that metal has been replaced with the ferrous and non-ferrous metals of iron, steel, tin; and with alloys of lead, antimony, spelter and combinations of these metals. In fact, wherever possible the baser metals have been used to cheapen the cost of production.

So we find the results of the workers of iron and brass in the finished product. The electro-plater, by his art, unites the craft into one common mass, and so it should be with this great brotherhood of workers in iron and brass. The electro-plater, on the common level, congratulates you upon this endeavor to unite your efforts and bids you "God speed."

In preparing this paper for your consideration it is with the one idea to present a few practical suggestions on the electro-deposition of brass upon baser metals, as I have found them in actual practice. As brass consists essentially of an alloy of two parts of copper to one of zinc, so we should expect that for the same alloy in the electro-depositing of brass the same essential proportions would be necessary to produce like results. But in making a careful study of this question in practice I have found that to produce like results from a two-and-one mixture it is necessary to use three parts of copper to one of zinc for the deposited alloy.

Of the various metallic deposits now employed by the plater there is none that gives so much trouble and needs such careful treatment, for good results, as the brass bath, and this is the consensus of opinion of nearly all platers. While this may be true in many cases, in my own practice I have found the brass bath as easy to keep in working condition as copper or nickel, silver or gold. There is one thing important for successful results in brass plating—that is a study of the alloys of copper and zinc to understand the variation of color resulting from the increase or decrease of the amount of copper employed. In the alloy of the foundry the two-and-one mixture produces the full yellow or rich brass. This color is produced with slight variation even when 80 parts of copper and 20 parts of zinc are used. When we go below the two-and-one mixture, even as low as equal parts of each metal, we find the yellow color still predominates. This variation of color in proportion to the mixture of the alloy is well understood by the brass foundryman, but to many of the electro-platers is an unknown quantity, and this is where the trouble comes in. It is not always the effect of too much cyanide, too much ammonia, or a too concentrated or an insufficiently dense bath, but to an excess of zinc that causes the trouble. This is shown by excessive spotting out, easily tarnished deposits, or depos-

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its that materially change their color when lacquered, for which the plater endeavors to find a remedy.

In the study of alloys, as mentioned, those below the two-and-one mixture, yellow colors, still predominate. As an example: Today the brass bath is normal; work has been accomplished all day with satisfactory results. Tomorrow a slight variation of color is noted with a tendency toward a slight reddish yellow. In nine cases out of ten an addition of zinc will be made when, according to the study of the alloys, copper should be added to reimburse the loss noted by the change in color. When it is remembered that copper is essentially the great factor in a well composed brass bath, which consists largely of this metal, and that zinc is withdrawn very slowly, the bath should be regulated with copper.

In the composition of brass baths there is very little change from the formulas prescribed by the great master Roseleur, whose directions stand pre-eminently above others in their successful working. This applies not only to brass solutions, but to nearly all metals that are employed in the art of electro deposition.

It is not necessary for me to go into details of formulas, for all platers know that a brass bath consists mainly of the carbonates of copper and zinc in their solvent of cyanide of potassium, with the additions of the sodium carbonate and bisulphite of soda as conducting salts to increase the electrical conductivity; there are also slight additions of ammonia to assist in maintaining color.

Some operators use anodes of copper constantly in their baths, adding zinc when necessary to maintain color. This is good practice, for with an anode surface of all copper the plater can make no mistakes as to the metal necessary to produce the desired color. In my own practice I use anodes of cast copper and zinc in the proportion of three anodes of copper to one of zinc. In this manner I find it possible to easily maintain a uniform deposit by the addition of cyanide and the soda salts, with occasionally an addition of the metallic salts. A slight amount of zinc dissolved in ammonia water, thrown towards the copper, will instantly change the color of the deposit.

I have stated that in the composition of brass baths there is nothing new; but I have in mind one compound that has appeared within the past year or two. I refer to cuprous sulphite or red copper compound, which is rapidly replacing the acetate and carbonate of copper in the production of deposits of copper, bronze and brass. The results obtained with this compound have been eminently satisfactory. Its use avoids to a large extent the trouble experienced in plating iron, in the nature of blistering. It also does away with this trouble in the deposits upon lead and its alloys.

A standard solution that can be made the basis of a copper, bronze or brass bath consists of:

Water	1	gallon
Cyanide of potassium	6	ounces
Cuprous sulphite	2½	"
Sodium bisulphite	2½	"

For the production of bronze or brass by this formula, carbonate of zinc is dissolved in cyanide of potassium and water in the proportion of one part carbonate to two parts cyanide, making a concentrated solution. By adding one-eighth part of the amount of cuprous sulphite used, a bronze bath will be the result; with the addition of one-fourth part a good brass bath will be obtained.

It will always be found more satisfactory, when producing deposits of alloys, to first prepare the copper bath, and then make the additions of zinc when the bath is in working condition.

COMPARATIVE CUPOLA PRACTICE

By W. S. McQuillan, Warren, Pa.

At the January meeting of the New York Foundry Foremen, the subject of cupola practice and melting ratios was brought up for discussion. Accordingly a list of questions was submitted to about 30 foundrymen, and they were requested to answer as accurately as possible regarding the working of the cupolas in their charge. About 20 answers were received, most of which have been tabulated in Tables I and II for comparison. Some were received, which were not fully carried out, and could not, therefore, be used very well, and still others, owing to the odd construction and shape of the cupola, could not be analyzed for comparison, and had to be left out of this paper.

While some of these records would make interesting studies in themselves, the figures in the tables, are approximate, and while, it is not claimed that they are correct in every particular, it is believed that they are a fair comparison and show the results obtained from a number of different cupolas, with the varying conditions under which they were worked.

Fuel.

The volume of coke was figured from 100 pounds of good Connellsville coke which measured 5,264 cubic inches, and of hard coal, at about one-half the volume of coke, as it was found that some foundrymen use coal and coke on their bed charge. It has been stated that the cupola is one of the simplest devices for melting cast iron, which may be true, but where speed, economy, and quality, are desired, a thorough knowledge of the conditions, and workings of the cupola are very essential. There are certain fixed laws governing the melting of iron in a cupola. If the conditions are made proper and in accordance with the requirements of the laws, certain definite results are bound to follow. A given quantity of heat imparted to a certain amount of iron will bring about the change which we call "melted." Cast iron melts, ordinarily, at about 2,200 degrees Fahr., but there are a few foundrymen who would find it fit for use at this temperature, as it would be so near the actual melting point that it would quickly chill back to the solid state before it could be poured. As this temperature causes the metal to just run, it is evident that it must be treated much higher in order to have the iron retain its fluidity after being taken from the cupola. It is generally understood that the portion of the fuel below the tuyeres is not capable of giving this extra heat, and hence the metal must receive it before it drops below this point. We must therefore, look to the fuel above the tuyeres to furnish this heat as the metal drops through on its way to the bottom. So we find that the height of bed above the tuyere is of much importance in giving us good hot iron quickly. If the bed is low, it may melt, but dropping as it does, directly into the cold blast as it enters the cupola, it is cooled, and the result is dull iron. We can easily understand by the blocking of the fire, in front of the tuyere after the blast is put on, the effect of the cold air upon the melted metal.

There is the other extreme, having the fuel bed too high above the tuyeres. In this case the intense heat existing in the melting zone is applied to the fuel above it, instead of acting directly upon the metal. We have not only a waste of fuel, but a waste of time waiting for the excess to burn away sufficiently to bring down the irons to the melting zone where they will be melted. Therefore, the height of fuel

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Table I.

Report	1	2	3		5	6	7	8	9	10	11	12	13	14	15
Diameter of cupola in inches	32	35	42	42	27	44	44	54	54	58	48	56	60	60	72
Area of cupola in square inches	804	962	1,385	1,385	572	1,521	1,521	2,290	2,290	2,642	1,809	2,463	2,827	2,827	1,071
100 pounds fuel will fill, inches	6.6	5.6	2.3	3.8	9.3	3.5	3.5	2.3	2.3	2.0	2.9	2.2	1.9	1.9	1.3
Weight of fuel on bed, pounds	450	650	1,000	650	350	1,300	1,000	1,400	2,000	2,000	1,300	3,000	1,700	1,800	2,500
Height of fuel on bed, inches	30	36.5	23	26	32	45	31.5	32	46	40	36.5	66	32	34	50
Height of fuel bed above tuyeres, ins	21	29.5	11	15	20	33	25	24	32	24	22.5	40	30	22	26
Height of tuyeres from sand bed, ins	11	7	12	11	12	12	9.5	7.5	14	16	14	25	2	12	24
Weight of coke above tuyeres, pounds	278	470	520	400	215	940	628	800	1,390	1,200	800	1,800	1,575	1,150	1,300
Weight of iron on bed, pounds	1,000	1,300	4,500	1,400	700	3,000	1,000	3,000	6,000	6,000	4,000	9,000	6,000	5,000	7,000
Ratio fuel above tuyeres	3.5	2.8	8.6	3.5	3.2	3.2	1.6	3.7	4.3	5.0	5.0	5.0	3.8	4.7	5.4
Ratio fuel on bed	2.2	2.0	4.5	2.3	2.0	2.3	1.0	2.1	3.0	3.0	3.7	3.0	3.5	3.8	2.8
Weight fuel succeeding charges, lbs	110	125	250	100	90	175	110	300	450	400	200	450	2,000	350	600
Ratio fuel succeeding charges	8.7	10.4	8.0	10.0	4.4	11.4	1.3	10.0	8.8	4.1	10.0	10.0	10.0	11.4	11.7
Weight of iron succeeding charges, lbs	1,000	1,300	2,000	1,000	400	2,000	1,500	3,000	4,000	4,000	2,000	4,500	2,000	4,000	7,600
Total weight of fuel, pounds	1,250	1,850	1,935	2,150	2,000	3,075	2,040	4,800	8,500	4,400	4,100	12,000	6,600	6,600	12,700
Total weight of iron, pounds	8,000	14,000	12,000	16,000	8,000	27,000	14,800	33,000	64,800	30,000	32,000	100,000	49,500	50,000	127,500
Grand ratio	6.4	7.5	6.2	7.6	4.0	8.8	7.2	6.9	7.5	6.3	7.8	8.0	7.5	8.3	10.0
Kind of fuel used	Light Coke	Coke	Coal & Coke	Coke	Coke	Coke	Coal & Coke	Coke	Coke	Coke	Coke & Coal	Coke	Coke	Coke	Solvay Coke
Fuel weighed or measured	M	W	M	M	W	W	W	W	M	W	M	W	M	W	W
Time of putting on blast, P. M	3:00	3:00	3:00	3:00	3:00	3:30	3:15	2:15	2:10	2:00	1:50	3:00	2:45	2:15	2:00
Time first iron melted, P. M	3:10	3:15	3:15	3:05	3:07	3:45	3:30	3:25	2:30	2:15	1:57	3:05	2:46	2:30	2:15
Time first iron tapped, P. M	3:20	3:20	3:30	3:10	3:15	3:50	3:48	2:30	2:50	2:25	2:01	3:20	2:51	2:50	2:22
Total time of heat from blast	2:20	1:30		1:30	1:05	2:00	1:30	1:50	3:00	1:30	3:40	4:30	2:15	2:20	9:45
Iron melted per minute, pounds	130	155		175	123	225	158	300	360	333	145	370	367	360	567
Class of work made	Gas Engine	Plate	Job	Light Job	Job	Boiler & Plate	Pumps & Job	Stove Plate	Boiler & Radiator	Pipe Ftg. Job	Med. Light	Rolls	Plate	Sanitary & Plate	Electrical
Diameter of blast pipe, inches	12	16	14	14	8	15	12	17	18	20	16	24	18	18	24
Area of blast pipe, square inches	113	201	154	154	50	176	113	227	254	314	201	452	254	254	452
Number of tuyeres	6	6* 2¼	6	6	6		8	6	6	6* 3	6	12	8	6	
Size of tuyeres, inches	4½ x 6	5 x 5	4 x 10	4 x 6	4 x 6		2¼ x 11	4½ x 13	10 x 7	7 x 12	4 x 6	6 x 12	4½ x 7½	7 x 10	
Area of tuyeres, square inches	116	170	240	144	144	336	198	429	420	546	144	648	270	420	706
Height of charging door, feet and inches	12	11 6	12	12 6	9 10	11	7 10	9 3	11 6	9	9 9	13 10	9 6	10 6	14
Pressure 20 minutes after blast, ounces	16	16	12	8		9½	13	13	14	16	8	16	8	8	13½
Slag is drawn						After 6 tons.									Every tap
Weight limestone or shells, pounds				75		125			40 per ton		50 per ton			50 per charge	
Do you mill sprue?	No	Yes	No	No	No	Yes	No	No	Yes	No	No	No	Yes	No	No
How often do you line up, months	6	6		6		6	3	6	10	7	6	8 to 10	6	12	6

*Six top and six bottom.

above the tuyeres is of much importance in getting good hot iron in the shortest time. Care should be taken to see that the bed is neither too high nor too low.

Cupola Efficiency.

The theory has been advanced that a cupola would melt faster around the edges than in the center. Others have claimed that the center would melt the faster. This is not proven by the figures, as we find that a 35-inch cupola melted 19½ pounds to the square foot, per minute, while a 72-inch cupola melted only twenty pounds per square foot, per minute. As the iron from the 35-inch cupola was used for stove plate, we must assume that it was very hot. We also find a 48-inch cupola melting over 15 pounds per square foot per minute, but this may be accounted for by the figures shown. We find that at least two conditions in the 48-inch cupola are opposed to fast melting, namely, the use of part coal, and the proportion of tuyere area to the cupola area, which is one to thirteen. Further, only eight ounces of blast obtains, which would indicate that not enough air was furnished this cupola. On the other hand, we find a 56-inch cupola melting over 21½ pounds per minute, per square foot. In this cupola, we find the proportion of tuyere area about one to less than four, with a blast pressure of 18 ounces. We also note that the two 54-inch cupolas, Nos. 8 and 9, are about equal in tuyere area and blast pressure, but No. 9 melts over 22½ pounds per square foot per minute, while No. 8 melts a little less than 19 pounds per square foot per minute. Here, we might assume that the higher fuel bed of No. 8, was the factor which gave No. 9 the faster speed of melting. Now, if we turn to No. 10, a 58-inch cupola, we find a still larger proportionate tuyere area and a smaller ratio per square foot per minute with a higher blast pressure (sixteen ounces.) Here again, we might assume that the fuel bed above the tuyeres is not high enough to produce the best results. As we must remember that the blast

Table II.

Report No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Diameter of cupola in inches	32	35	42	42	27	44	44	54	54	58	48	56	60	60	72
Area of cupola in square inches	804	962	1,386	1,386	572	1,521	1,521	2,290	2,290	2,642	1,810	2,463	2,828	2,828	4,072
Tuyere area in square inches	116	170	240	144	144	336	198	429	420	546	144	648	270	420	106
Ratio of tuyere area to cupola area	6.93	5.66	5.57	9.62	3.97	4.23	7.68	5.33	5.45	4.83	12.84	3.80	10.47	6.73	5.76
Blast pressure in ounces	16	16	12	8	9	9	13	13	14	16	8	16	8	8	13
Melt in pounds per square foot per minute	9.54	19.45	.....	18.19	15.12	20.87	15.22	18.87	22.64	18.14	10.08	21.60	18.80	18.40	20.06
Fuel bed above tuyeres, in inches	21	29.5	.....	15	20	33	25	24	32	24	25.5	40	30	22	26
Ratio of first charge	2.2	2.0	.....	2.3	2.0	2.3	1.0	2.1	3.0	3.0	3.7	3.0	3.5	3.8	2.8
Tuyeres from sand bed, in inches	11	7	12	11	12	12	10	8	14	16	14	25	2	12	24

pressure will cool a large part of the fuel, and raise the melting zone, so we will say, if this fuel bed was 6 inches to 8 inches higher, the melting rate would be more in proportion with No. 9, or if the blast pressure was reduced two or three ounces, faster melting would result. We may also note No. 4, a 44-inch cupola melting 18.19 pounds per square foot, per minute. The tuyere area here is about 9½ to 1. The blast pressure is low for this proportion, but we may also note that the fuel bed is low and maintained so, by small succeeding charges of fuel and iron. In this cupola we have personal knowledge of the good quality and temperature of the metal produced, and believe these conditions to be due to blast and fuel being kept in good proportion.

Conclusions.

From these few comparisons, we arrive at the conclusion, that fuel and blast must be kept in certain relations to obtain fast and economical melting. There are many other studies that could be made from the tables presented, from which you may draw conclusions which doubtless would tend to establish the following facts:

That with a high fuel bed and a high blast pressure the melting zone is raised and a cooling of the fuel around and above the tuyeres results. It also chills the iron and slag over the tuyeres and causes the cupola to bung up at this point.

That a high fuel bed and a low blast pressure cause delay and waste of fuel by having to burn out a portion before the iron will reach the melting zone.

That a low fuel bed and a high blast pressure will cause dull iron by cooling.

There is one other condition which affects the melting ratio, and perhaps contributes more to the waste of fuel than any other. This is the height of tuyeres from the bottom. Also the construction of some cupolas having two rows of tuyeres. As we must consider the fuel below the tuyeres as only a foundation to keep the effective fuel at a proper height, and as these high tuyere cupolas have for their object the holding of metal in the bottom sufficient to pour large pieces, this provision would seem unnecessary.

As we will note, by referring to No. 13, the tuyeres in this 60-inch cupola are but two inches above the sand bottom, the iron was used to pour very light work and ran in a stream at the rate of 370 pounds per minute, filling a 2,000-pound ladle in a little over five minutes. It could be held for some time, retain its heat and be free from slag and dirt.

Further than what has been shown, we do not desire to make a comparison as to the melting ratio. Different kinds of work may be poured at different temperatures which fact should be taken into consideration in the study of the tables. We do not claim to be cupola experts but believe that you will find the figures given of interest to you.

THE INDUCTION FURNACE FOR THE PRODUCTION OF STEEL BY ELECTRICITY

The induction furnace for the production of steel by electricity has been successfully operated abroad for the past seven years and in this country for about one and one-half years. It is now claimed that the process is commercially established, and that the product is not only of a high quality but is attained at less cost than by the best type of fuel furnaces. The number of plants now installed and under way fully demonstrates an appreciation of these facts by some of the foremost steel manufacturers of the world.

The induction furnace is equally well adapted for the general manufacture of alloys. The temperatures are under absolute control, may be maintained automatically constant at a predetermined point or quickly raised to the vaporizing point of the melted charge. Heat is developed directly in the charge to be treated, radiation losses are thereby reduced to a minimum, maintenance and operation costs are lessened, and a dense and homogeneous product is easily obtained.

Principle of Construction and Operation.

The furnace represents in principle a static transformer such as is everywhere used for transforming alternating currents, the charge of metal to be melted forming the secondary winding of a single turn. As is generally known, if an alternating current is sent through a coil consisting of several turns of an insulating conductor around a magnetic core built up of laminated iron, a strong alternating magnetic field is set up in the core. This field, by the action of induction, causes a secondary current to circulate in a second conductor placed around the core, with no direct connection between the two. As the field strength is proportional to the number of turns and the current flowing in the primary coil, the current flowing in the charge which forms the secondary coil is also proportional to the current flowing in the primary coil. That is to say the current in the secondary will be approximately equal to the primary current multiplied by the number of primary turns. Thus if we have 100 amperes and 100 turns in the primary, we obtain approximately 10,000 amperes in the secondary.

The amount of current flowing in the molten bath of a 100 kilowatt furnace would be roughly 30,000 amperes. The heat developed in the secondary is proportional to the square of the current flowing through it. The heat is thus actually produced in the charge itself, without electrodes or external heat. By this means it is possible to heat the charge to any desired temperature without allowing it to come in contact with injurious products of combustion, such as carbon, sulphur, gases, etc. No expensive electrodes which dissipate energy, exert a carbonizing effect on the charge, and require frequent renewals, or large copper conductors are required.

Since the heat is developed directly in the charge without interposing radiating surfaces, the furnace is a melting machine of great efficiency.

Unless, however, the core, primary and secondary coils are properly designed and constructed, the power factor and efficiency will be very low, and the cost of operation will be prohibitive.

With all other forms of construction it is necessary to use primary currents of very low frequency which compensate in a slight measure for the low

power factor obtained. This means that special current generating apparatus will be required costing from 50 to 75 per cent more than standard generators usually carried in stock by the electrical manufacturing companies. It is also impossible to obtain current for operating any other type furnace from the central station power plants without using very expensive changing apparatus.

The primary coils of the furnaces are constructed of copper wire strip or tubing as required to meet the conditions of service. The heat generated in the coil by the current is dissipated by means of an air blast or by the circulation of water through the coil itself in the case of copper tube coils. The coil is protected when such protection is necessary from the heat generated in the secondary by means of a water jacket between the lining case and the coil. When the copper tube coils are used the water jacket is seldom required. Insulation for the coils is formed of incombustible materials and is designed according to the best engineering practice.

The furnaces will be furnished as stationary types with slag and metal tapholes, or will be arranged to tilt allowing the slag and metal to be poured over the edge of the crucible, the latter type being usually preferred.

The lining is built of materials best adapted to the material to be treated and method of working, and is usually rammed in place around a template. Regular repairs are necessary only at the slag line, and the faulty places are therefore always exposed after tapping and can be attended to before recharging the furnace.

Arrangement of Plant.

As every manufacturer has different ideas in regard to the general arrangement and operation of a plant, it is difficult to say that any one arrangement is best, and it will be sufficient for us to give a brief account of the actual operation of the 170 kilowatt furnace at Gysinge, Sweden.

This furnace is of the stationary type with the charging platform on about the same level as the upper edge of the melting trough or crucible, which is slightly raised above the surrounding brickwork. On the charging platform are the switchboard, the scales for weighing the charge, and a small forge and anvil for making the forging tests, when the charge under treatment is completely melted and the leading hand at the furnace has made the colorimetry test, the material to form the next charge is weighed, and placed in readiness near the furnace. Immediately after tapping the material is charged, as a rule in two portions, each portion in one quarter of an hour, and the interval between portions one hour. In about two hours from the time the charging begins the whole of the material is melted, and at the end of another hour the carbon content is checked colorimetrically and by the forging test, and is corrected if too low by adding a little pig iron, and if too high by the addition of pure ore. About a quarter of an hour before tapping about 22 to 33 pounds of 12 per cent ferro-silicon is added, to insure that the ingots are free from blowholes. The charge is run off into a ladle lined with fire clay and carried on a crane, and if the metal is not quiescent a very small quantity of pure aluminum (about 1¼ ounces for a whole charge) is added. The ingot molds which receive the metal are placed on a turntable underneath. These are of the ordinary construction, being two-part and held together with hoops tightened with wedges. The total quantity tapped being about 1,850 pounds, in different size ingots as required. The time of one heat is four hours, and with so short an interval between charging the ingot molds do not require much warming up, and they are only blackened inside with burning Swedish resin to give the ingots a smooth surface.

A furnace now in operaton at Disston's Works in Philadelphia furnishes metal for ingots weighing 90 pounds, about 40 kilowatts of energy being re-

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quired for the operation of the furnace and one heat being obtained each hour.

Comparison With Other Methods.

It has frequently been asserted that the induction furnace, or indeed any type of electric furnace can produce high class crucible steel from inferior materials, or even direct from iron ore. These statements are misleading. Impurities can be reduced to a certain extent in the furnace by adding "physic" and rusty scrap iron can be properly reduced. High class iron ore can also be reduced to pig iron in the induction furnace, but for such work, power must be had at very low rates. The furnace is a modified crucible furnace, high grade raw material, as used hitherto must still be used for producing high class steel, but the induction furnace permits of larger casts, a cheaper and cleaner form of melting and reduced cost of labor. Steel of the open-hearth quality may be produced from the material usually used for the purpose. At present crucible steel is made by remelting crude steel in crucibles, by which means the kind of steel best adapted for cutting tools are obtained, or pig and wrought iron are melted together in the crucible forming a mixture suitable for making steel castings. In these methods reaction takes place between the material composing the crucible and its contents plays an important part. The steel takes up silicon from the refractory clay, and if graphite crucibles are used carbon is also absorbed. The same high density and freedom from gas obtained with the crucible process is also secured with this type of induction furnace.

In making crucible steel, the furnace which generates the greatest amount of heat under exact control will give the best results. Perfect heat control is obtained with the induction furnace by simple methods of varying the primary current and thus controlling the current flowing in the crucible. Therefore the induction furnace is perfectly adapted for the production of the finest grades of this kind of steel. There is no possibility of the metal becoming contaminated from the electrodes, and no gases are in contact with the metal. In addition to these purely technical advantages, there is also the important one of economy, through being able to dispense with the costly crucible.

The demand for large crucible quality ingots is increasing day by day, many ingots are required for various purposes several tons in weight and the crucible steel maker is confronted with really practical difficulties in making these large ingots, taking into consideration the number of pots to be teemed, and the possible variation in quality. The induction furnace solves this problem, for it is as easy to make a two ton charge in such a furnace as a 90 pound charge in a crucible.

Costs of Steel Production, Crucible Practice.

For purposes of comparison it will be well to note the following figures taken from actual tests under normal conditions. The furnace, for instance, in operation at Gysinge, Sweden, requires for its operation 165 to 170 kilowatts of electrical energy and has a mean capacity of 3,000 pounds of metal the quantity tapped at one time being about 1,850 pounds and the time required for one heat four hours. With all of the material cast added cold, the average consumption of energy was 800 kilowatt hours per ton. Electrical energy may be purchased from $0.003 per kilowatt hours up. The furnace lining was in service for 12 weeks and with it a total of 285 tons of steel was melted, the upkeep of furnace lining per ton of steel being about $0.60.

The expenses corresponding to outlay in fuel and crucibles in the crucible process with energy at $0.005 per kilowatt hours would be:

800 kilowatt hours at $0.005	$4.00
Cost of lining per ton of steel	.75
Total	$4.75

The average waste of material during a long period of operation has been proved to be only 2 per cent and this amount is allowed for in the above figures.

According to competent authorities the cost of fuel and crucibles in the crucible process would be:

2,650 pounds coal	$3.00
Upkeep of crucibles per ton of steel	15.00
Total	$18.00

In these calculations the saving in wages has not been considered at all, the cost of material is about the same for both processes, and the cost of molds, general expenses and supervision are about equal. Two men and one boy are able to run a furnace turning out four tons in 24 hours so the saving in the cost of labor is considerable.

In working with hot metal, from the blast furnace, a charge of 1,430 pounds of molten pig iron was poured into the empty furnace and 2,860 pounds of cold pig and scrap was added. In six and three quarter hours with 182 kilowatts the charge was finished, the consumption of energy being 650 kilowatts hours per ton allowing for 2 per cent wastage.

Open Hearth Practice.

In order to compare the induction furnace with the open-hearth process, it will be necessary on account of the larger scale of production of the latter furnace to consider a much larger induction furnace. A furnace of 736 kilowatt yields (owing to reduced loss by conduction and radiation) 30 tons daily with cold charging and 36 tons daily when charging with hot metal. An ordinary open-hearth furnace yields about 48 tons per day, these figures of course are based on the scrap process. The waste in an open-hearth furnace amounts to about 5 per cent and in this respect the induction furnace with its waste of 2 per cent works more economically. The quality of the raw materials would of course be that usually employed for the manufacture of steel on a large scale, and not of the special purity required for crucible steel. The product of the induction furnace under these conditions would not be of the quality of crucible steel, but it would certainly be as much superior to ordinary mild open-hearth steel, as steel manufactured in crucibles from inferior raw material would be.

The uniformity of the chemical composition is all that could be desired. In the open-hearth furnace the decarbonization continues up to the end of heat, and recarbonization becomes necessary. With the induction furnace process, no decarbonization takes place after melting, and there is sufficient time after making the colorimetry test to maintain a definite proportion by making suitable additions. The life of the basic lining, which is three months, is much longer than the open-hearth lining, which from competent sources is only two months. The cost of the lining for the induction furnace is approximately ten cents per ton of steel melted, and the electrical energy required is 590 kilowatt hours per ton with cold charges, and 490 kilowatt hours per ton for hot charges.

Furnaces Now in Operation or in Course of Construction.

	No.	Amount of Charge, Pounds.	Capacity per 24 hrs.	Kilowatts required for Operation
Disston Steel Works, Philadelphia, Pa	1	150	2,100	40
Gysinge, Sweden	1	3,000	11,000	170
International Calcium Co., Curtnellen, Switzerland	1	7,500	22,400	320
Roechling Iron Works, Voelkingen, Germany	1	130	480	75
Roechling Iron Works, Voelkingen, Germany	1	660	2,500	110-120
Roechling Iron Works, Voelkingen, Germany	1	53,700	168,000	736
Roechling Iron Works, Voelkingen, Germany	1	300,000	.....	...
Krupp Works, Essen, Germany	1	54,000	170,000	746
Vickers Sons & Maxim, England	1	1,500	7,500	130
Araya, Spain	1	7,500	22,400	320
Poldihuette Co., Austria	1	7,500	22,400	320
Guldsmedshyttan, Sweden	1	7,500	22,400	320

COST ACCOUNTS

By H. F. J. Porter, New York.

We frequently see the statement in print and more frequently hear it said that although the value of principles of cost accounting has been recognized for some twenty-five years, still it has been only a comparatively short time since manufacturers generally have established cost accounting systems in their plants and thus know accurately what their product is costing them. Now, while I am willing to concede the fact that cost accounting has to a very large extent become recognized as a permanent feature in the financial end of a great many industrial enterprises during recent years, still I know from personal experience that it does not follow as a corollary that the accurate cost of production has in every instance been attained.

But presuming for the moment that the result mentioned has actually been accomplished, I feel that I am safe in stating that there is a wrong conception in the minds of many people as to what the function of a cost accounting system really is. I have heard people who have had a system of cost accounting installed in their plant say that they were disappointed in its not accomplishing the saving that they had been led to expect would be brought about by its introduction; that on the contrary, there had been an increase in expense by just the amount it cost to run the cost system. To my mind, and to the minds of many who have had to do with manufacturing enterprises, the aim of an efficient cost system should not be to determine simply what a product costs but rather why it costs what it does. People nowadays are not satisfied to be informed that a condition exists, but demand to know the reason why, so that if necessary it can be modified intelligently. It is intelligent action on the information presented by the cost system that accomplishes the saving, and not the system itself that does it.

This result is by no means always attained by cost systems as they are generally operated, and while there are many and diverse reasons for this, the foremost is the expense of installation and operation, and I want to emphasize strongly the distinction which I shall make later between these two operations, viz.: the installation and the subsequent operation.

Installation of Cost System.

First of all, it requires a competent and experienced man to design and install a suitable and comprehensive cost system. The services of such a man are in great demand just now and, therefore, necessarily come high, and this expense, together with the cost of employment of those who are subsequently to operate the system, all of whom will swell the ranks of the non-producers, deter many from making the proper investment. In fact I have heard some people say they feel perfectly able to install their own system, and resent the suggestion that an outsider do it for them as a reflection upon their own competency.

These people do not recognize the distinction between the ability to design and install and the more simple qualification to subsequently operate. The first is that of a recognized specialist, the latter that of a first class bookkeeper. Very few have the former, but all concerns have the latter in their employ. The only way they could be considered competent, would be by having on their regular staff a man of the first type, and if they were thus equipped the inference

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would be that they were paying continuously too much for occasional expert supervision.

There is no more need for the continuous service of such a man in an ordinary business than there would be, for instance, for an engine designer in the same business. When an engine is to be bought to operate a plant, people do not design and build one. They go to a firm of engine manufacturers and get them to supply a suitable engine and install it. The subsequent operation of the engine is another matter that is entrusted to regular mechanics. And so the now recognized profession of constructive accountancy should be similarly dealt with, if what is wanted is to obtain the character of cost system, which is needed in a growing business, viz.: one which is adapted especially to its needs and will be flexible enough to adapt itself to changes as they develop.

The essential features of this system of costs must conform to the general commercial accounting system of the business, so that they merge and become one. After the system is installed, it can be handled by the staff of bookkeepers already employed, with such additions as the increased amount of work necessitates. The type of manager which every industrial enterprise should have nowadays is one who has received some technical education and will be able to analyze the statements presented regularly by the cost system, draw his deductions and act intelligently upon them. In other words, the subsequent success of the cost system will be measured by the ability of the manager to make use of it. Those who do not have a cost specialist on their staff, if they feel as I have intimated some do feel about securing an outsider of this type, when called upon to develop a system of cost accounting, are very apt to fall back on their own resources and put in a simple "Labor and Material Record" account, distributing the general expense over the output according to the ratio of direct to indirect labor. This gives the cost of product, according to their notions, and they let it go at that until competition suddenly opens their eyes to the fact that there must be something wrong somewhere, and then there is trouble for somebody, and generally the most innocent suffers.

Cost Specialist.

There are, however, many concerns who have realized the nature and value of the work of a cost specialist and have gone to the expense of having a high grade system installed. But it is surprising how few of even these systems remain operative at their full efficiency. This failure to secure the desired result after the lapse of time seems to be due to the lack of recognition of the human element in the office force engaged in the work. It takes a good man to keep a high grade cost system abreast of the demands of a growing business. Good men are always in demand, and a day arrives when this good man finds an opportunity presented whereby he can better himself. Here again the hesitancy to increase the cost of the non-productive element in the business asserts itself and he is allowed to go. His successor is either a new man or one advanced from the ranks. He suggests changes, simplifications, cutting out of what he or others consider superfluous records; these changes do not work out as well as was expected, others are substituted, and before it is realized, the system has lost its vitality and flexibility and degenerates into a simple "Cost of Product" system.

Simple Systems.

Now, these "Simple Systems" which cost so little to operate, are rarely accurate in their results and are not productive of the saving that was expected. Simple engines do not require expensive men to handle them, but there is, on the other hand, a continuous draught upon the coal bin, the oil tank and elsewhere. And so it is that in the saving in operation of the simple "Cost of Product" sys-

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tem there are leaks in the labor and material accounts which do not localize themselves, and therefore, are not apparent.

There is no part of a manufacturing business where metals are handled that receives as little attention in the cost department as that which deals with the raw materials. It is generally supposed that where materials are roughly handled in bulk by unskilled labor, no accurate methods of accounting can be applied, and consequently the most crude records, both of time expended and materials handled are kept. Averages only are dealt with, and in some instances records are taken only at intervals to see whether conditions change. Such records are worse than valueless; they are deceptive, and the principal object of a cost system is to prevent deception.

Cost Variations.

The best way to become convinced that records taken at intervals are unreliable, and therefore unsatisfactory, is to translate them into graphical curves. It will then become apparent, by the distance between the peaks and depressions in the curves, how greatly costs can vary, and when gaps occur, regret will be felt at the lack of knowledge of what has happened during the intervals, and there will be a constant tendency towards requiring that records be supplied regularly, so that the curves will be made continuous.

The value of a statement when made by itself may be small, and yet when compared with some other similar statement, its full bearing on the subject under consideration is shown, and its importance may become very great. Curves show the relative importance of grouped statements, and any variation becomes so striking to the sense of sight as to demand instant investigation.

Let me then urge the advisability of keeping records of the cost of each item of your output every day and all day. Find out what each item costs, so as to learn which is paying and which is not. Try to change however, so many different kinds of your manufacturing methods so as to make your unprofitable product pay, and if you find you cannot do so at market prices, then drop it and let someone else who can, make something on it.

Try to systematize your processes so that there is a continuous flow of product from the receiving of the raw material to the shipping of the finished product. Remember that every machine and every man in the plant represents capital invested; that when machine or man is idle, just so much capital is not drawing interest, and that the more the machine and the man produce in a given time the greater is the interest on the capital invested. A part of this interest is one of the factors of the profits of the business; the other part should be set aside as a fund to make good the antiquation and deterioration of the machine, and for a long service pension for the man when he also has worn out. The more continuously the machines operate the better interest they pay; therefore, do not change the work they are set up to perform oftener than is necessary. The more continuously men work the better interest they pay, for they are keeping the machines from being idle.

Therefore, it will pay to employ men who are steady, who are at their machines every day and all day. These men, even if their output per hour is lower than that of others who are classed as better mechanics but who are less steady, deliver a greater output per week or per month at less cost. A high grade cost accounting system in the hands of scientific management will bring individual plants to their highest efficiency of operation.

In any independent industry it is possible to get the individuals who comprise it to co-operate towards a standardization of methods of cost accounting. If the making of castings stood independently as an industry, a movement of this kind in it would be of

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very great advantage. There are, industries which incorporate a foundry as a regular department in their business that it would be impossible to attempt to do more than suggest, by establishing precedents, the general lines which it would be advisable for them to follow. This you can do, and I hope that your initiatives will be followed.

SANDLESS CASTINGS

By John H. Shaw.

Casting in so-called chills is a method well known at the present time. Outside of the making of rolls and ingot molds, we find the method used for making bedsteads, sash weights, and other simple castings where there is no difficulty from undue expansion and contraction. The troubles arising from an iron mold, and the lack of understanding the regulation of temperatures in casting into chills, have caused many a failure of an otherwise good idea.

The greater part of these objections have been overcome by the construction of a peculiarly arranged mold, as shown in Figs. 1 and 2. The parts of the mold are so arranged that they automatically open out sufficiently to take care of the expansion due to heating without destroying the correctness of the castings made. The further manipulation of the molds in filling them with molten iron depends upon a proper knowledge of the temperature they must be kept at to insure the best all around results.

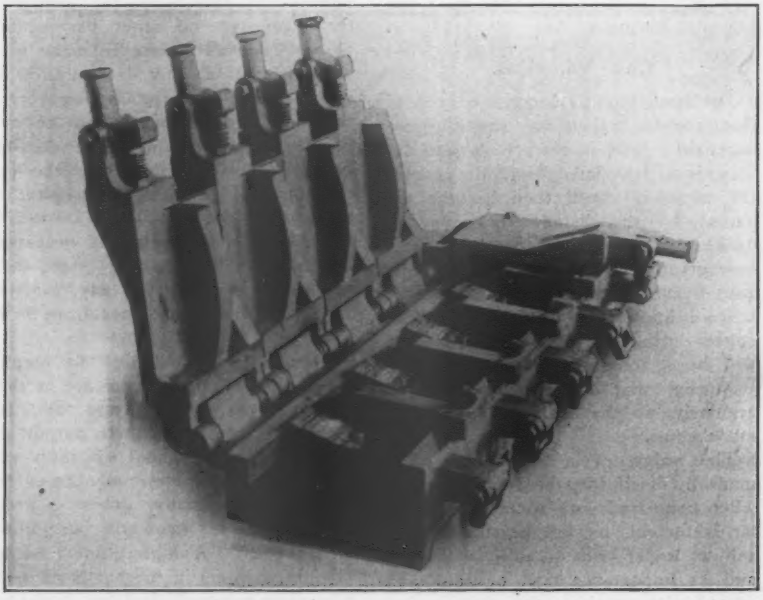

Fig. 1—M. C. B. A. Brakeshoe Mold.

Construction of the Mold.

The mold is constructed essentially in two parts; the outer shell which

may be locked readily, and the inner dies in close contact with the shell, and securely fastened to it. The design of the mold is such that expansion in two directions may readily take place unhindered except for powerful springs. The arrangement of dies and shell allows of a ready replacement of the former when damaged, this depending upon the thickness of the mold and the temperature they are allowed to reach, their composition, of course being such that a high melting point is attained. Further attention is given to the molds in designing them, so that they may be closed and opened very quickly, and thus rapid work accomplished.

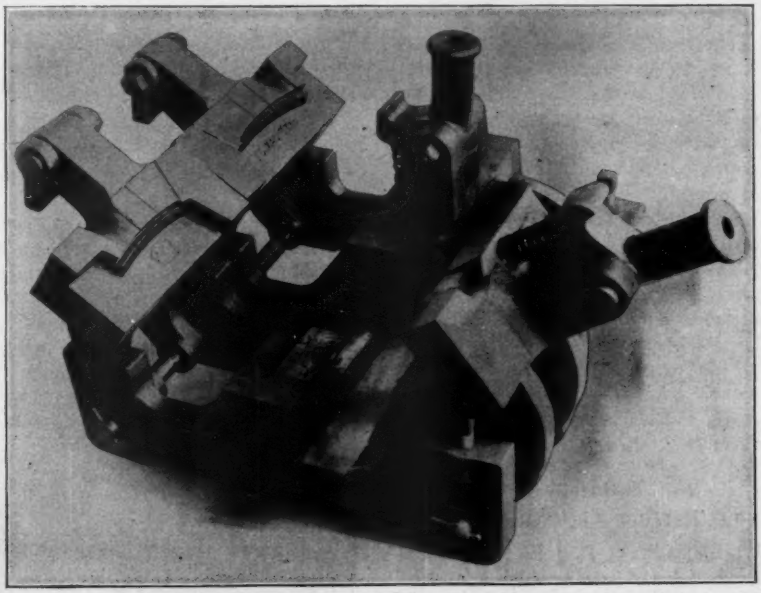

FIG. 2—KEYSTONE BRAKE SHOE MOLD

Operating the Mold.

In operating a sandless mold, it is necessary to coat the metal in contact with the molten iron occasionally with a compound containing graphite and crude oil, or other refractory substance carried in a vehicle which in being driven off by heat will not ruin the surface of the casting.

In operating the mold, after spraying it, the first few castings are rejected, the intention being to heat up the mold, though in continuous work, this may be accomplished in a special heating furnace or oven if desired. All cores are set in the regular way before casting. The metal is poured in rapidly, and the mold opened as quickly as possible provided that the metal is set sufficiently that no bleeding takes place. The elastic condition of the mold however, prevents trouble if this time is not kept properly and the casting allowed to remain in the mold too long, the disadvantage of such a procedure in allowing the mold to heat up too much is naturally evident. The casting is then taken out and piled up so that the whole mass may cool slowly, so that the chilling effect of too rapid cooling may not cause hard spots.

The molds should not be allowed to get too hot, that is beyond 900 degrees Fahr., otherwise they are liable to expand permanently and cause trouble.

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Coating the Dies.

It is only necessary to coat the dies every fifth pouring, more or less, the idea being to get a thin layer of the refractory material evenly spread over the face of the dies, which layer is properly kept up. Between this and a hot mold, and fairly soft iron, no undue chilling effect results in the casting beyond the very desirable closing up of the grain of the metal. In the case in point, the making of brake-shoes, every fifth cast requires a spraying of the mold.

The system can of course be adapted to mechanical elaboration in order to get the lowest shop cost. Thus by performing many of the small operations automatically, by special devices, or arranging the molds to pass the point of pouring, much labor can be saved. The work that can be made by sandless molds is naturally of a standard kind, where large quantities of the same piece are required. Hence its introduction for the brake-shoe, iron bedstead, and other work. Moreover for the car wheel, the usual cold chill, with a suitable adaptation of a center core makes a very easily handled wheel.

Disadvantages.

In presenting a method to the foundry, it is always well to look at both sides of the problem. That is to show its advantages and disadvantages. Here are the latter.

The sandless mold is best adapted only to work of fairly large size, though practically everything can be made in this way if proper care is taken in the niceties of the construction and manipulation.

The heating of the mold consumes some time and uses metal which must be returned to the cupola, though this can be avoided by heating in the oven. Molds are naturally expensive at first, and hence advisable only when a large number of castings are to be made of a kind.

The red hot castings, if small, where machinery is to be done, or special requirements are demanded, must be practically annealed, either in pile, or by an oven. The silicon of the metal also must be a little higher than for sand castings.

Advantages.

The advantages are as follows:

A limited number of molds will make a large number of castings with very little labor, and this is not high class.

The surface of the castings being practically smooth, and accurate in dimensions, the loss of extra metal through excessive rapping of patterns in sand work is avoided, and no expensive cleaning department is required beyond some little grinding of thin fins.

The life of the molds is long, as may be seen in ingot molds for brass, and iron bedsteads.

The foundry plant is very small for a heavy tonnage.

The process is adaptable for continuous melting and operating.

Interchangeability of the dies in the shell makes it easy to keep the molds up to standard, and these dies being of cast iron are inexpensive.

The installation of an expensive power plant is eliminated, the only power required being electricity sufficient to run cupola blower.

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PROCEEDINGS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION

In Convention at Philadelphia, May 21, 22 and 23, 1907

Minutes of the Meeting

President McFadden called the meeting to order about 10 a. m., May 21.

DR. E. E. BROWN—Mr. President: Philadelphia has many things to be proud of. None of them, however, are we more proud of than our Mayor. I take pleasure in introducing to you Hon. John E. Reyburn, Mayor of Philadelphia.

MAYOR REYBURN—Mr. Chairman, ladies and gentlemen. Some of the members remarked to me this morning, "This is a hard crowd." I can hardly believe this when I look around me and recollect the compliment Dr. Brown has paid the Mayor. Philadelphia is a great city. In fact, if you were to go about with me and spend one or two days here, you would begin to realize that it was a tremendous city, not only in the extent of country that it covers but in population and in the industries.

And the industries represented here today are very prominent in those of Philadelphia. Therefore it is with a great deal of pleasure that I, as mayor, welcome you to this city, and hope that you will have a pleasant, agreeable, and profitable time as well, for these things all have not only their enjoyable side, but they have the profitable side, as they justly should have. They bring those interested together and show them the things that have been accomplished; and by this exchange of ideas and of object lessons as you see them out there in the exhibition, a great improvement is brought about. They educate, build up, and strengthen not only the business, but the individuals engaged in that business. People are very much improved and broadened in their views by these exhibitions and by the coming together of the various interests.

Philadelphia has been very fortunate this last spring in having many of these conventions and I assure you that it has been a great advantage to the ruler of the city; because, as you may well understand, he gets ideas and instruction from these conventions and meeting the men and the women who assemble at them. They all represent some great interest and in that way I get ideas and get an education that otherwise would take me months to hunt out and familiarize myself with.

I at first thought that possibly at times the attendance at conventions was a waste of time; but I have changed my mind completely upon that subject and I believe I can be of no better service to the people of Philadelphia than by constantly meeting just such organizations as are before me today. I will be better enlightened and better fitted for the duties I have to administer.

Now I have come here today—and I am very much obliged to the committee for giving me the privilege—because I know that I will receive a benefit from the contact I have had already with the people that are here assembled. Mr. Chairman, I therefore want to express to you and to your organization the great pleasure I have had in being here, and again renew assurances that the people of Philadelphia are very glad to see you all; in fact, I might just as well tell you, you can have the town while you are here if you want it, and if anybody attempts to interrupt you—why, just telephone to headquarters and that will end it. I want to impress that on your minds, really—that I am not here just simply because I had a duty to perform, but I am here because I am glad to be here and because I know it will be a good thing for me, and a good thing for you, and a good thing for the people of Philadelphia.

XUM

THE PRESIDENT—Before introducing the next speaker I want to say in behalf of our people here it is not necessary to thank the Mayor for his welcome collectively; I think they have individually expressed the appreciation felt by their countenances when the Mayor made his address. The pleasure thus exhibited, I think, your Honor, will demonstrate the fullest appreciation of your kindly welcome.

President McFadden next introduced Mr. Thos. Devlin, president of the Philadelphia Foundrymen's Association.

THOS. DEVLIN—Gentlemen of the A. F. A. and allied associations, ladies and guests—as president of the Philadelphia Foundrymen's Association I extend to you in its behalf a very hearty and cordial welcome to the "City of Brotherly Love."

The city in which in 1776 our freedom and independence was first proclaimed and where the first congress met, and where the bell in sounding the death knell of bondage cracked its side. The place and the deeds are hallowed and memorable.

This city still continues to be the birthplace of notable events, as in 1895 the A. F. A. was conceived and delivered in swaddling clothes to the tender care of the Hon. John A. Penton whose foresight pictured great possibilities for the youngster.

Not long after that time a union offspring of the Philadelphia Foundrymen's Association and the convention of 1896 made its appearance in the National Founders' Association, whose aims and objects seemed to enlist Mr. Penton's consideration, rather than the dry, difficult and often disputed scientific problems which the A. F. A. were preparing to tackle, hence Mr. Penton busied himself in securing a successor to whom he could entrust the precious charge. It was not long before he discovered the man he wanted, whose mind was a regular storehouse overflowing with just the right kind of knowledge and with ripe experience. To whom it would make no difference whether as president, secretary or treasurer, his care for the Philadelphia babe would not cease, but would fondly cherish and guide until it took its place, if not in the lead, at least in the front ranks of the foundrymen's asscciations of the world.

My attempt at drawing a word picture of the man is far from perfect, owing to the fact that I do not want to tell all I know in his presence, but I am pretty sure you know to whom I refer—Dr. Moldenke—whose name is almost a household word.

Great men in performing stupendous works select competent assistants, and where could the Doctor or his associates of the A. F. A. have gone to secure more able counsel and aid in rearing the Philadelphia babe, which in its eleventh year is a wonder of strength and vigor, than to Pittsburg—a city unequalled for colossal works, fortunes and men of brains, but I am sorry to say some of their top crust do not compare in all that is great and good with the men whose whole desire seems to be to carry to completion anything intrusted to their charge, and such a man gentlemen, is the president of the A. F. A.—Mr. McFadden.

The members may not all know what he has accomplished, nor the time and energy given to the work, but your secretary can, and no doubt will tell you how ably he performed his part ever since you elected him to preside over your deliberations.

A brief allusion to the history of the A. F. A., which is, I believe, the successor of the first association of foundrymen ever held in the United States. There were two beginnings made between 1884 and 1891, but the third and successful attempt was made November 4, 1891, with Francis Schuman as president, and Howard Evans, secretary, and while I am satisfied Mr. Schuman's ability and energy contributed much towards its permanent organization, still I hold to the belief that had not Howard Evans become a member and its secretary, it would never have withstood the withering blasts of winter nor the oppressive summer heat to which it has been subjected, by the neglect of members to give proper encouragement at the time most needed.

XUM

The success was not of the spasmodic order, but very slow and to the ordinary man would have been very discouraging; but Mr. Evans stood up bravely, yes, even hopefully, and labored constantly and untiringly with success as his goal.

Mr. Schuman ably seconded his efforts, also Mr. Wenner and Mr. Rankin, each a great worker in the cause.

The association had formulated and defined its object and purpose to be the advancement of the foundry trade. To collect information leading up to the cost of castings, and the selling of same at a fair profit, etc.

The membership was liberal and included not only foundry owners but foremen and others whose services were valuable.

My opinion of all such associations is that more good is accomplished by meeting our competitors and talking with them, because we learn, if not to love, at least to respect them, which in my humble opinion, means much in business.

The idea of calling a national convention of foundrymen originated, I believe, with Mr. Howard Evans. It was favorably received and discussed by the members and had the hearty cooperation of the president, Mr. Schuman.

The original intention was to encourage the formation of foundrymen's associations in every city in the union, and the annual convention to be composed of delegates elected by each association to meet for the purpose of having papers read and discussed and to furnish all the associations the net result of the practical and special information thus obtained, with the chaff and rubbish eliminated, and such the A. F. A is now doing for us, and doing it perhaps quite as well if not better than by the methods originally suggested.

There may be some listening to me who feel like saying, "I wish the old man would cut it out," in other words, stop talking, but even old men have their place.

One day, two years ago, as I sat in the office of a customer on the other side of the water, the boss came in and I was introduced; I had my hat off, and without further ado, he asked permission to congratulate me as he was not aware men lived in this country to have gray hair. Oh, I said, I went into the foundry business when a boy, 52 years ago, and the man who employed me is living and well; which is still true.

I saw at once what he meant, that Americans rush and push to secure filthy lucre so hard and persistently that they kill themselves in youth by their strenuous efforts.

I wish you all a very pleasant time while in our city, and the supply men a profitable as well as a pleasant time.

As the Mayor of this slow old town has given you the keys, just imagine yourselves boys again, and if you do, you will probably leave with the impression that it is not such a slow place after all.

President McFadden next introduced Dr. E. E. Brown, chairman of the Philadelphia Committee of Entertainment.

DR. E. E. BROWN—Mr. President, ladies and gentlemen: Foreman Reyburn has molded you in the flask of good fellowship; foreman Devlin has poured the mold with good words; and the entertainment committee have passed on the castings, pronounced them good, and each casting has been separately labelled.

The city, as the Mayor has told you, is yours; Atlantic City we have annexed for the benefit of the visiting ladies, and it is theirs; the entertainment committee is yours.

THE SECRETARY—Mr. Bentz, president of the New England Foundrymen's Association, sends greetings and best wishes on behalf of that association for a very fine and markedly successful meeting in Philadelphia.

THE PRESIDENT—I think it is hardly necessary for the president to say anything in response to the worthy Mayor's remarks; and in behalf of Mr. Devlin, who has gone back to the birth of the association and did not omit anything from the infancy up to the present moment. He has covered the entire scope. I will not say anything in connection with the birth and progress of our association now because I hope to do so in the address with which I will follow a little later.

XUM

I always looked upon Dr. Brown as being quite a portly, large man; only yesterday I made the remark that he was the largest large man I ever met, by the way he has carried out the arrangements for the entertainment of the American Foundrymen's Association. I can speak from experience of just the beginning. I had the pleasure of getting a start last night; if it keeps up at that pace, I can assure you that I coincide with Mr. Devlin's remark that Philadelphia is not asleep, as it was not at the hour I left this morning.

It would be useless for me to attempt to talk on the different subjects of interest at this time. As president of the association and chairman of the meeting I heartily express the same wishes for the success of this organization. In behalf of the Pittsburg Foundrymen's Association and its members, some thirty strong who came over from Pittsburg to attend the Philadelphia meeting—that we appreciate the honor of the invitation from Philadelphia and expect to partake of its hospitality and if necessary "call up headquarters" for relief. I might say, a little further, in behalf of our friend, Howard Evans, secretary of the Philadelphia Foundrymen's Association, who wrote me a nice letter some time ago, that I informed your worthy secretary of the Philadelphia Foundrymen's Association that it might be necessary, while I was in Philadelphia, to call upon him in a financial way; so I see he has appeared on the scene this morning; and if the Mayor does not make good, I am going to make Mr. Evans responsible for carrying out his end of putting up the velvet for any of the members or friends or guests of the American Foundrymen's Association while in Philadelphia.

President McFadden next introduced Mr. S. T. Johnston, president of the Foundry Supply Association.

PRESIDENT JOHNSTON—Mr. President, Ladies and Gentlemen: The Mayor referred to these meetings as enjoyable, wonderfully instructive, and object lessons—true object lessons. I trust you will make good use of us here. We have tried to gather together a goodly array of exhibits; and I am told that a number of the exhibitors have a goodly array of souvenirs; I hope you will all make yourselves welcome to them.

We are glad of the opportunity to help the American Foundrymen's Association to do its work. We believe we have also done so with our presence and otherwise; but this year we have gone a step further and have an exhibit which I don't believe has ever been equalled anywhere in the world. We thank you very much indeed for coming to see us and our exhibit.

President McFadden then read his address which, will be found in the Transactions, page 69. On motion of vice-president Caley, a hearty vote of thanks was tendered the president for the careful analysis and presentation of the objects and efforts of the association, as well as for the recommendations which are expected to be acted upon by the executive board to be newly elected.

Dr. Richard Moldenke, secretary-treasurer, then presented the following report:

It is with great pleasure that I am able to report great progress for the year just passed. Thanks to the well directed efforts of our president, Mr. McFadden, the membership of our association has grown fully 75 per cent, which in itself is a remarkable fact considering the conservatism of the trade and the difficulty of getting men who compete with each other together. Our vice presidents have also assisted your secretary materially in bringing up the membership, so that today we are 532 strong. There have been but few resignations during the year, and no one was dropped for non-payment of dues. Our hearty thanks are due to our good officers, who have given their time and means in furthering the good work to the lasting benefit of the foundry industry.

The financial condition of the association is also an excellent one:

Income from dues, sales, etc.	$2,847.45
Expense for the transactions	303.41
Salaries	1,200.00
Printing	198.35
Postage	383.00
Sundry	8.75
Balance	$ 753.94

No traveling expense has been charged to the association, but while the balance looks large, most of it is on account of dues paid in advance for the coming year by the new members just received. The result is, nevertheless, highly gratifying, and argues well for the future of our work.

The year has been a remarkable one. Everybody has been busy, and probably little time has been given to experimenting and research. Nevertheless, your secretary's office has been a bureau of information of very widespread influence, and has doubtless saved many dollars for the foundrymen who have taken advantage of its existence. Hardly a week passes but that several inquiries come in from people desirous of embarking in the business of making castings of all kinds and descriptions. It is a case of "don't" most of the time, which advice, if followed, saves many heartaches for those who would suffer from misdirected competition. No one can complain of legitimate competition when based on a thorough understanding of costs, but a plunge on the part of one unacquainted with the pitfalls of making castings often leaves a trail of ruin in the territory which he affects.

The wonderful success of the exhibition of foundry machines and appliances shown at Cleveland, has stimulated everybody to such an extent that I know parties here now who come specifically for the purpose of purchasing their equipment, after studying the various types offered. Perhaps in no industry are mechanical appliances wanted more badly than in the foundry, and with the enterprise shown by our supply men in placing their best and all before us at one place and time, I venture to predict that this feature of our conventions will do more lasting good for the trade than anything else we can offer. Seeing is believing to most of our conservative foundrymen, and here they have what they cannot get away from, considering that their competitors also have eyes to see and brains to calculate prospective profits.

I would continue to urge foundrymen to join the association. The complaint is heard everywhere that there are too many associations to belong to. This is true in a sense. So far as we are concerned, let the foundrymen take out a membership and delegate their foundry superintendents, foremen, pattern foremen, metallurgists and chief accountants to keep track of the work done, and call it not an expense, but an investment. You will hardly realize how deep our work has sunken into the minds of those who are up against foundry problems. I have at home stacks of letters from foundry foremen asking all kinds of information, begging for it under stress of difficulties they are put into by the purchase of irons unsuited for their work. They write, "Our firm is not a member of your association, in fact does not want to go to the expense—but please let me know how I can use iron which analyses so and so for this work. I have paid for the analysis out of my own pocket to see why I cannot get results which my firm says I should," etc.

Others have troubles which can be traced to bad coke or bad cupola practice, but all want to know, and learn the principles of their business thoroughly. This refers especially to the operatives of the shop. The owners also write me hundreds of letters, but they want financial information, costs, estimates, etc. Your secretary makes it a rule to answer everyone as fully as possible. He is inclined to draw the line on nonmembers when the correspondence gets over five-page letters, but can truthfully state that no foundry foreman has ever proved ungrateful for advice and help given from our office, while this cannot always be said of their employers. We're therefore thankful to our Philadelphia hosts that they have drawn the line on the entertainment of their guests to include only mem-

bers of the various associations invited. This rule will be kept up in the future.

I would, again, emphasize the fact that very few foundrymen realize that their employes are highly anxious to learn all they can, and no better opportunity can be given them to see and hear, compare notes, and benefit their employers, than to take out a membership in the association, and send the best men to the conventions.

Among the matters of interest to us that have occurred during the year are the following: There has been formed an association for the promotion of industrial education, which promises to do much toward the solution of that vexed but all important problem of where we are to get our supply of trained mechanics in the future. Our vice president. Stanley G. Flagg Jr., represented us at the dedication of the Engineering building of the University of Pennsylvania, and your secretary did the same for the United Engineering building in New York, the gift of Mr. Carnegie. The government tests on coke for foundry purposes were continued, and congress has appropriated further funds, some of which are to be used for the study of the cupola. I would respectfully ask this association to authorize a committee from its membership to aid in this work with their advice and co-operation.

We have to again thank the publishers of THE FOUNDRY for their kindness in saving us very much money in the publication of our transactions. We sincerely hope that this may be amply repaid them by our members in other ways.

There will be formed an association of brass founders and allied interests at this convention, if those who come for this purpose so decide. We wish this movement every success, and if it can chronicle as much good to the brass industry as we feel we have done for our foundries, the nation will indeed have been the gainer.

The better financial situation will enable us to continue the publication of our instruction papers. The one recently issued brought such a flood of letters and orders for the preceding numbers, that I feel justified in recommending the broadening out of this work as much as possible. Our Mr. Field, who looks after the metallurgical part of this work, and our Mr. West, for the molding, have consented to continue the good work. We hope further to do something for the patternmaker, coremaker, etc., so that a firm by placing these short, easily read papers into the hands of their intelligent young men, a direct improvement will result. The foreman, of course, will be the man to go over the information with the men, and we know that our modern foremen are only too glad to help in this work.

In conclusion I want to thank our officers and membership for the unfailing courtesy with which they have assisted me in the somewhat arduous task of trying to hold the dignity and work of our association up to the level demanded by the times. Nothing should please us more than to see information spread broadcast so that the nation may benefit, and its resources be utilized to the best advantage. Let us continue the good work with renewed vigor and strive to lift the foundry industry still higher than it already is.

The secretary also read the report of the committee on standardizing the methods of analysis of cast iron. This report is printed in the Transactions on page 44. Report adopted. Mr. David Spence then read his paper on "Sound Castings," (page 67), which was briefly discussed.

PRESIDENT MCFADDEN—We will now hear from Mr. Kenneth Falconer, chairman of the committee on cost accounts.

MR. FALCONER—At the last convention of this association a committee was appointed to study the question of "Uniform Methods of Cost Finding" applicable to the foundry business, and to report at this convention.

The three questions naturally relating to this matter, and to be considered by your committee are:

First—Is it desirable that individuals, firms and corporations engaged in the manufacture and sale of castings should figure their costs and make up their estimates for selling purposes on similar lines?

Second—Do the members of this association figure their costs and make up their estimates for selling purposes on similar lines, or are their costs and estimates figured on a different basis?

Third—Is it possible for this association to secure a standard definition of costs and standard methods of figuring costs, and making estimates for selling purposes?

As to whether uniformity in methods of cost finding is desirable, the mere appointment of your committee is sufficient answer. We have, however, the precedent of other associations, such as the Steel Founders' Society, the Jobbing Founders' Association, the Stove Founders' Association, and the Malleable Iron Founders' Association, who have all at one time or another given attention to the question of uniform methods of cost finding and taken action thereon.

Series of Questions.

Since the last convention, your committee prepared a series of questions this association, and which related to the methods of cost finding and of estimating. The replies to these questions have been carefully studied and tabulated. They demonstrate very clearly that, in the business in which we are all interested, that is, the manufacture and sale of castings, there is no uniformity whatever regarding the figuring of costs for record, and making of estimates for selling purposes. To take the one point of distribution of overhead expenses, one reply received stated that the writer had an elaborate system by which he was able to distribute each item of general expense accurately and properly on each casting manufactured. A reply received from another member of the association stated that overhead expenses were distributed "any old way, and I wish I didn't have a foundry." It goes without saying, that if these two members of our association were in competition for local business, such competition would not be the intelligent competition which makes for the life of trade, but would rather be the unintelligent competition which is destructive to both competitors. Competition by a manufacturer who knows his costs is a much easier competition to meet than competition of a competitor based either on guess work as to costs, or a more or less inaccurate knowledge as to market prices.

Ways of Securing Cost Methods.

If it is the feeling of this association that it is desirable to adopt standard methods of figuring costs and of making estimates for selling purposes, there are three ways by which these results may be secured:

First—By following the plan usually adopted, where a number of industrial organizations have been merged or combined, that is, by appointing a committee on costs to visit the different plants represented, examine conditions, and advise with those in control. This plan is, however, impracticable in the case of an association such as this, the plants concerned being so widely scattered, and the conditions under which they operate so different.

Second—A committee might be appointed to study the question currently, and report from time to time, obtaining the views of members of the association regarding the various points connected with cost finding and estimating. While this would possibly be a better way in the case of a local association meeting frequently, it would not work in the case of a national association, such as ours, meeting at such long intervals.

The third alternative is for the association to obtain the services of a specialist to outline a practical cost system, embodying in itself the general principles applicable to the foundry business, the details being purely suggestive, and subject

to change and modification when applied to the plant or establishment of any member of the American Foundrymen's Association.

The last plan mentioned would appear to your committee to be the most feasible, but unfortunately, the association is not in a position to take up the matter on a scale involving any considerable expenditure of money. Moreover, the question of cost finding is of much greater importance to some of our members than to others. To some foundrymen, a proper cost system is a matter of commercial life or death, while to others it is simply a convenience, as for instance, in the case of machinery concerns, whose foundry product does not enter into the market as such, but as a portion of a finished machine, sold as a machine, and not as castings.

In consequence of these conditions, your committee has considered the matter with a view to devising, if possible, some means by which the expenditure, while limited in amount, would not entail any outlay on the part of those members of the association not interested in the matter.

Your committee believes this can be accomplished, and suggests that either the present committee on costs be continued, or a new committee appointed, authorized to receive subscriptions for a limited amount from those interested; the money so raised to be expended for the services of specialists to prepare a report, and for the cost of placing it in the hands of subscribers, in printed form.

Cost System.

Without entering into a multiplicity of details, your committee has very clearly in mind just how far it would be well to go. We would not recommend or approve of securing for this association any elaborate detailed scheme, but we have in mind simply the presentation of the basic rules of foundry cost finding, and an outline of simple methods which, if followed by the different members of this association, would result in establishing a uniform basis on which to figure costs and estimates. In other words, your committee strongly recommends that the American Foundrymen's Association should put itself on record to endorse the establishment of a common and standard definition for the use of members of the association when speaking of costs, when figuring costs, and when making estimates for selling purposes.

The answers to the questions sent out by your committee very clearly indicate that items regarded by one foundryman as overhead expense, or general indirect cost, are entirely different from those so regarded by other foundrymen. The replies show that the rate for overhead expenses amongst the 23 per cent of members who calculated these expenses on labor ranges from 2 per cent to 200 per cent.

For purposes of discussion, it makes no difference whatever whether the expense rate calculated on the labor cost is high or low, for the cost of the foundry's product may be high or low as a result of many different factors. It is, however, of very great significance if the rate on labor be high or low on account of including or omitting to include items of indirect cost, which one foundry may regard as included in his overhead expenses, while another foundryman does not regard them as part of the cost of his product.

MR. FIELD—After having discussed the matter with the chairman of this committee I would make a motion, in order that the question may be brought formally before the convention. I would therefore move that the present committee on costs be reappointed; that the secretary be authorized to spend a limited amount for the purpose of outlining a complete and thorough system of cost finding applicable to the manufacture of castings, and prepare this in printed form for the use of our members.

MR. FLAGG—Did Mr. Falconer arrange the reports or replies given to him in response to his circular letter; if so, is he ready to give it out at this meeting?

XUM

MR. FALCONER—The replies which I received to those questions sent out by your committee have been tabulated. I have not them with me; but they will be published with the proceedings.

PRESIDENT MCFADDEN—We have with us Mr. Kreutzpointner, who will talk to us on the supply of skilled labor for the future.

MR. KREUTZPOINTNER—Mr. President, gentlemen: In lieu of Mr. Alexander, who was unavoidably detained, I take the liberty of making a few remarks on the supply of skilled labor.

We all know that the economic conditions of the day have brought up the question of an adequate supply of skilled labor in our shops; and it has become a very prominent question. Some corporations have begun to establish training schools in their own shops. There are other means to provide for the future a supply of skilled labor; but the opinions vary as to the best methods. An effort is being made to solve the question of education in some of the shops. However, it is one of great expense, waste of energy and opportunity. Only the very largest shops, with a very large number of apprentices, can afford to have a school of their own; as, for instance, the Westinghouse Electric Co. Very few shops have the opportunity, as I had last winter, of taking young men, sixty and seventy at a time, out into different works; or, for instance, call them out in squads during the daytime of seventeen at a time and show them the forging of steel, the manufacture of car wheels, etc.

There is another way, however, where smaller shops in conjunction with our present manual training schools, for which some of the citizens of Philadelphia are now working, can avail themselves for producing the future supply of skilled labor. This work is slower, but more effective, more fundamental, and more economical for the smaller shops. However, there is one difficulty that will have to be overcome, and that is, that our educational system at the present time has nothing to offer in order to prepare the young people, as they come from school, for the duties and the trades which the young men and boys are expected to follow in the course of time. That is, in other words, we have nothing in our educational system to provide for a vocational education, and the best thing the manufacturers—the foundrymen as well as all business men and employers—can do, is to acquaint the school people with the necessities, the various requirements for the fundamental and preparatory education of young men and the boys as they come from the school for the different trades.

Our manual and trade schools offer a very rich field in that direction. However, thus far manual training, and even the trade schools which have been established in a few cities, have aimed too much in the direction of merely providing manual dexterity; and in order to provide that skilled labor which in the near future is necessary, and will be required in all our shops, some kind of a technical education must be also provided in our manual training and trade schools. This is one of the principal requirements for all associations, and the Foundrymen's Association especially—to associate themselves as much as possible with the teaching systems at hand; to acquaint the schools with the needs of the foundries and the needs of the business men and manufacturers, so that they understand how to provide those preparatory schools which are necessary.

The school people, the school associations, the National Educational Association, the Pennsylvania State Teachers' Association, the Manual Training and Art Teachers' Association are continually trying to find a way to meet the needs of our manufacturers; but at present they do not exactly understand those needs; and it is now up to the foundrymen and all other associations to acquaint the school people with what they need, and then a good, solid foundation will be laid and in the very near future, when with our American industry, energy and quickness of perception, it will be but a very few years that a sufficient supply of skilled labor will be provided.

THE PRESIDENT—The report of the auditing committee is now in order.

XUM

J. S. SEAMAN—I wish to report that the audit has been made and found correct. I wish to add, at the same time, that we have this year a state of affairs we have never had since the organization of this association—we have got a surplus in the treasury, which possibly is gratifying to all the members, and it is caused by the action of our worthy president and secretary. We will have a little more to say in regard to that matter tonight. All I wish to report now is that we are in good shape; our membership has increased very much; and everybody appears to be anxious and falling over each other to pay his dues; and such being the case, the treasury would naturally be in good shape.

THE PRESIDENT—Next is a paper from Mr. Herbert E. Field, Pittsburg.

HERBERT E. FIELD—I want to just call your attention to one or two things which Dr. Moldenke and I have tried to do, and that is, to get some knowledge on the effect of different elements on cast iron into our proceedings. In the natural course of events, in every new thing there is a whole lot published that is not correct. I do not claim any originality, simply this, that I think I have eliminated all that is not correct, and I have gathered what is correct in comparatively few words. Mr. Field read his paper on "Manganese in Cast Iron," page 22 of the Transactions.

Meeting adjourned.

Second Session.

Second session, May 21, 2:30 P. M. Opened by president McFadden, who called upon Mr. Henry B. Cutter of Seneca Falls, N. Y., to read his paper on "Cast Thread Fittings." (Page 59 of the Transactions.) The following discussion took place:

A MEMBER—I would like to know how many parts the core box has.

MR. CUTTER—This is a two-part core box. The core has no seam, as you notice. That was made on the special device I speak of.

SAME MEMBER—How do you get the box off the thread?

MR. CUTTER—That is part of the special machine. I would like to state I do not hesitate to answer any question in connection with this, for the reason that "misery likes company." I have had a good deal of misery in connection with this work, and if anyone would like to try it, I would like him to have the trouble. I first entered the foundry industry four years ago, before that time I don't remember having been in a foundry, or seeing a heat poured off; and if any one had asked me then what a core was, I might have thought possibly they were referring to an apple core, certainly I could not have told you how a casting was made. I speak of this for this reason that I found it was absolutely necessary for me to study this industry to make a successful issue of it; that I had to educate myself, and I sought information from many who had grown gray in the industry. I found there was a great deal of mystery thrown around foundry practice. A man who had a great deal of knowledge gained it by experience—that seemed to be his stock in trade; and it was very difficult for me to get the information which I desired; but I am glad to say that as I have come to this my first convention I find there is a letting down of the bars, as it were—more of a tendency to assist in educating each other. I myself disbelieve in tying up any secret or any special method, that I may possess from anyone eles that might desire that knowledge; but that is the experience which I found when I first entered the foundry business.

A MEMBER—What kind of sand is that core made of?

MR. CUTTER—Ordinary bank sand. We use the Mills core compound. This sample is made with a double quantity of the bond, in order to make it hard, that is all; but in practice we have the core much softer.

A MEMBER—How large fittings do you make?

MR. CUTTER—Eight inches.

SAME MEMBER—Have you found in cleaning them in a tumbling barrel, if you do clean them in that way, that the threads inside the fittings are damaged?

MR. CUTTER—Sometimes this will happen; but that is only the sharp edge

which according to the United States standard is not required anyhow; but that sharp edge does not help make a tight joint; it is the sides of the thread that make the tight joint; so that if that sharp edge is slightly injured it does not affect the making up of the joint at all.

MR. WALKER—Do you depend on that shoulder at the back of the joint?

MR. CUTTER—This is a drainage fitting. The shoulder is a peculiarity of drainage recessed fittings. It has nothing to do with the joint. The thread has got the standard pitch of all steam threads.

A MEMBER—Do you have very much trouble with defective threads in casting? What is the percentage of loss?

MR. CUTTER—I should say perhaps 2½ per cent. Our method of assembling the cores obviates that very largely.

Mr. Edward B. Gilmour followed with his paper on the "Evolution of the Foundry Business," page 53 of Transactions. It was discussed as follows—

A MEMBER—This machine is supposed to run continuously, is it not?

MR. GILMOUR—Yes sir, the machine will run continuously, providing you can take care of the molds as fast as the machine produces them.

MR. CALEY—Suppose you want to ram molds of different hardness, how will the machine produce this change?

MR. GILMOUR—There is a brake wheel on back of the machine which is regulated by a small hand wheel attached to a screw which you can tighten or release so as to compress the wads of sand to any degree you want. We made a casting for a lawn roller section, 24 inches in diameter by 12 inches deep. We took three sections of flasks, 5 inches each with this pattern, and rammed it in about 1½ minutes and the casting is now on exhibition at about the middle of the building. You will notice that there is only one little swollen lump on the casting. There was no rammer put in it. It is just as it came from the sand, not even cleaned. You can see it for yourselves.

A MEMBER—Suppose you had a sheave wheel to make, how would you ram the sheave part?

MR. GILMOUR—You would simply make your pattern in two halves and make the sheave part in a core, as it would be impossible for any machine to ram under any pattern, anyone knows that.

A MEMBER—How would you ram up a soil pipe?

MR. GILMOUR—A soil pipe can be very easily rammed up, if you get a machine long enough to take in the pipe. You can tip the table in order to ram up the one side, then reverse the position of the table in order to ram up the other side. It revolves in any direction desired. This table is held in position by a brake attached to the side of the machine which can be released at will for the different positions of the table so as to suit to the ramming.

MR. CALEY—Have you a special machine for every kind of casting required?

MR. GILMOUR—No sir; this is the most universal molding machine ever produced. You can take any split pattern, place one-half on a board and have the other half for your copy. We have made all our flasks of one size so that there is only one set of equipment. We simply fill up the flask as full as it can hold and pour everything by crane ladle.

MR. WEST—I would like to ask Mr. Gilmour if a machine is not working in Philadelphia.

MR. GILMOUR—Yes sir; there was one put in operation last Monday. I understand there are automobiles running out to the foundry to show any individual the machine in operation, and you can also see the casting, which is the best proof of its efficiency. It is installed at the Bernstein plant. Anybody can go out and see it running. But there are samples of more intricate work which were made on our machine than are being made at the Bernstein plant and they are on exhibition.

President McFadden then called on Mr. West to read his paper on the "Gray Iron Foundry as a Business Venture." Before doing this the secretary explained how the three papers on similar subjects—the gray iron, the malleable, and the steel foundry as business ventures—came to be written.

After Mr. West had read his paper, and Mr. Walker had complimented him on the thoughts expressed, Dr. R. Moldenke, the secretary, read his paper on the "Malleable Iron Foundry as a Business Venture." This was discussed as follows:

MR. POPE—Might I ask the Doctor if the amount required to turn out a minimum of 5 tons daily was $40,000.

THE SECRETARY—Not quite that way. I meant to convey that if it takes $10,000 in equipment, etc., to turn out 5 tons of gray iron castings daily, it would take similarly $40,000 to produce the same tonnage in malleable castings. By good practice, however, this same plant could be forced up to a production of 15 tons daily.

MR. POPE—My reason for asking the question was to induce some one making malleable castings in the United States to go up to Canada, to London, Ont., where we want a plant, and are willing to stand behind it with a portion of the capital required.

MR. HIRSHHEIMER—Your tonnage of 5 tons is a pretty small minimum for malleable.

THE SECRETARY—I have known of some works to run about ¾-ton a day; but you see they use those castings for manufacturing purposes themselves. Something like gas stoves. They sell these. The malleable parts are very small on a gas stove, and probably ¾-ton a day runs a pretty big plant.

The manufacturing side of the business makes the profits. They tell us that 4,000 of the 6,000 foundries in this country don't know what the castings cost them; so it is with manufacturing plants. If they did know what their foundries cost them, per pound of castings, they probably would be very careful. I had to do with a foundry once which had a manufacturing department. They didn't know what those castings cost them either. I found out that it cost them 3½c a pound, and the molders were turning out about 90 pounds a day on the average. Before we were through the production was sent to about 250 pounds per man, and 2¼c a pound represented the cost of the castings.

Very often five tons would be called high. You could go lower than that, providing you made the money on something else; but I would not think it advisable to go below five tons for the plant capacity. That means that you can get 10 to 12 tons out of that plant but with five tons as a minimum daily. You might make one heat every two days, and you can make from one to three heats every day out of the same equipment.

MR. HIRSHHEIMER—You couldn't run your air furnace economically on a small tonnage. It is not as economical, is it?

THE SECRETARY—When we speak about 3 tons of castings that usually means about six tons melted. The sprues of your malleable plant are a very, very heavy percentage. In large malleable works they can go about 30 per cent; in very small castings, they run up to 75 per cent of the heat. Some foundrymen actually take their sprues and make ingots out of them for remelting afterwards.

MR. HIRSHHEIMER—We figured it would be cheaper to buy our malleable castings or, in other words, cheaper to keep out of the business.

THE SECRETARY—Depends upon the prices. You get a price, for instance, for malleable castings as high as 5c or 6c a pound, that is one thing; but when you are up against railroad work—when you have got to make castings for 2c a pound with pig iron worth to $14.50 a ton you are pretty near bed rock. I remember the time when pig iron was $12 a ton that we sold castings for a shade less than 2c a pound delivered, and just made expenses; but that was at the rate of 50 tons a day.

MR. KREUTZPOINTNER—During my 36 years' experience I have come across many little ventures which have invariably failed. That was true 36 years ago and that was true last year, when the latest example of that kind came up for my observation. As a rule, 95 per cent out of a hundred of founders of that kind have failed in small malleable iron works, and in the big ones they have different troubles.

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H. M. Lane read a paper entitled "Small Points in the Core Room Which Are Not Considered," which appears under a slightly different title on page 94. The following was taken by the stenographer at the President's suggestion, as the speaker was not following the paper closely:

One little point often neglected is a mere matter of the designating mark on the metal core box. If you place that so that when the hand is handling the core box—the thumb or finger rubs across the designating mark—it will keep a bright spot and you can see it; but when you are making small cores and the box is in very frequent use, other parts of it frequently become gummy and the designating number, or mark, becomes filled up and you have got to take the scraper and scrape it off; and you don't get all the number scraped off and you make a mistake. Those are little things, but they are important.

The point of testing a machine made core to see whether it is properly baked is another important factor. I know a number of foundries where the core in the oven always stands with the bend toward you. The rule in the baking of an ordinary core is, in the first place, the driving out of the moisture. If there is any moisture in there it will instantly condense on the surface of the dry rod, and if you draw it out you will see whether it is perfectly baked or not.

It is with the small cores, that can be made in large quantities, that the greatest saving can usually be made. One point often neglected is, that the core maker is expected to hustle for everything for himself, first for the rods, to get his material—his sand, etc.; then, secondly, get it over and prepare it. If you have a large output of cores, it will pay you to systematize your core room the same as you systematize your machine shop or your foundry, and you get the greatest output if the man stays at the bench and makes the cores and somebody else takes them away and somebody else brings in the material.

Primarily, the baking of a flour core, or any similar core is a drying process, varied by a baking process, in which the character of the flour or binder itself is actually changed in the baking; it is made into a bread. For some classes of castings the baking is continued until the bread is partially rotted so that the core will crush easily in the mold. A bread of itself thoroughly baked—biscuit, you know—is brittle. In the same way a thoroughly dried or baked flour core is brittle and will crush as the metal shrinks upon it. That is one advantage that cores of that kind have over some other classes of cores; but there is a point before you get to the proper baking temperature when you are liable to leave the core fairly hard. One man has been proposing the use of water glass in cores. I bring it up, as it illustrates a very interesting point. When you take sand and add water glass to it, you make an artificial sandstone. Naturally sandstone is nothing in the world but sand grains cemented together with silica, with a silicious bond in ordinary cases. When you take water glass and add it to sand, you make an artificial sandstone; and the more you bake it, within certain limits, you will begin to dry out the water of crystallization and actually change the silicate—the harder the thing gets; and, of course, at the tremendous high temperature of the steel casting, the water of crystallization would be driven out on the surface and in many cases the core would crush; but in brass or bronzes, with their lower temperatures, the probabilities are you would have a broken casting. At least, that is as far as experiments I know have gone; and it is the way the matter appears. In making those same cores with other bonds that either belong to the flour class or the glue class or the liquid binder class, you have a somewhat different set of conditions; and when you make a flour, or a binder with any one of the pastes or flours, the material which binds the sand stays in the same bond in which you put it during the entire baking process, and the only method in which you harden the core is to harden that binder. When you hard-

en the core with a binder belonging to the hardening class including pitch, resin and oil and all the binders that flow under heat, you have a somewhat different action. The core is soft during the heating process and becomes harder as it cools—very hard, in some cases. There is an oxidation process going on which renders it hard—hot also; but those cores, most of them, do not become actually hard under great heat. Reheating a resin core will soften it; so that when you put it back into a casting and reheat it, you will soften it.

Now as to linseed oil cores. You have a core hardened by an ozidizing process. Linseed oil paint is hardened by the oxidation of the oil in the paint; and that takes place by slow degrees through a long period. In a core you simply hasten the hardening by heat; and the circulation of air through your core oven will harden it very much quicker. Of course, there is some hardening due to the evaporation of more volatile constituents of the compound; but the process is nevertheless largely an oxidizing process. Linseed oil cores if exposed to moderate temperature long enough would harden quite satisfactorily; but would still contain the amount of moisture which it originally contained, unless you carried it above the evaporation point of water. If heated in an oven at the proper temperature, with the proper circulation of air, you oxidize it.

That brings us to a very important point; and that is, the fact that in heating in the core oven the thing you are trying to do is to get rid of moisture. As the air goes into your oven you should have it as dry as possible. Core ovens are usually put into any old place. They should not be located where they will not obtain as dry air for their supply as possible.

One man had an air duct running across his boiler room; and right near the end of this duct he used to draw the ashes out and wet them down, and there was constant steam rising at intervals during the day. He used to suck in all that steam and blow it into the cupola. It was a little warmer than the ordinary air; but he would have had a very much higher melting efficiency if he had gone out of doors and gotten the coldest, driest air into his cupola. If you take hot damp air and heat it to a little higher temperature and then attempt to use it to extract moisture out of a core, it won't do it because it has not the capacity to carry moisture. You reach the dew-point before you get it out of your oven; and hence in the core oven you should have the driest air supplied that can conveniently be obtained. Of course, your heat comes through your fire in most cases.

Coke is an ideal core oven fuel for this reason. The products of combustion of coke are carbon dioxide, which contains no moisture, and hence will dry air. It has the greatest ability to absorb and carry out moisture. If you take the same core oven and fire it with a fuel that is a hydrocarbon—oil, or natural gas—in which one of the products of combustion is water, which goes off as steam—you have loaded your air, to begin with, with moisture; and you are loading it with the very thing that you wanted to have taken out, and hence you won't be able to extract as much moisture as you would with a fuel the products of combustion of which are dry. If you are simply baking cores in a short oven and letting your heat go out at a high temperature, you won't succeed there. You should have a tandem arrangement in which the cores are dried in one part of the oven and baked in another; that is, the air goes through the partially baked cores driving out the last of the moisture and strikes the damp cores and dries the rest of the moisture.

I know several places where core ovens are being operated on that plan; a core being shoved into one oven and partially baked and drawn back and transferred and shoved into another for the finished baking; or, by a continuous process, the cores being advanced through the oven in such a way that the green cores come in contact with the outgoing air. In that way the full efficiency of your core oven can be very greatly increased.

MR. CUTTER—I introduced a form of condenser in core ovens in the shape of a coil of pipe, with cold water gradually

flowing through it and the condensation from the core oven on the pipes going off away from the oven. I found very great benefits from it; and I would like to know if there is anyone else has had any such experience, or what the results have been.

MR. LANE—The condenser should originally be placed before the core ovens before the air opening, so as to make it as dry as possible. I know in drying ware, which is a similar process —my father was in that business when I was a boy and I used to go around the potteries with him, and saw some of the very first experiments in this country in drying ware with steam—we ran into some curious experiences. One of them was with a drier, a room about as wide as this and several times as long, and about as high, in which the ware was packed, green ware, with steam coils below. That was before we had the fans for driving a current of air through it. We had openings in the floor and in the ceiling and allowed the air to rise and carry out the moisture above. The Irishman having charge of the rooms, looking at those holes in the top and bottom, said: "Bedad! that's no way to dry ware. You are letting all the heat out," and he went and got some dry goods boxes and closed the openings. It got hot enough, all right, and there was no circulation of air. During the day time there was circulation in there, so the ware would dry some, but at night they had one rack of ware just about ready to go into the baking room, and they would have a rack of green ware, and the next morning the moisture had gone from the green ware to the dry ware and the whole room was damp ware and that which had been practically dried was back so that it would take several hours to put it in condition again. My father came up there and knocked those boards off and started a circulation, and it wasn't but a little while before we had the whole thing going all right again.

On another occasion the air of the factory was quite damp and we secured a supply of water for the condensers and for the boilers through pipes, and drew the air for this drying room over them, so that in humid weather the moisture was taken out as much as possible making the air dry and cold before putting it through the heating apparatus, so that it would extract moisture there, the idea being that air at 70 degrees Fahr. will contain a certain amount of moisture; at 100 degrees it will hold, I believe, more than twice as much.

You see, that the air in the core room only absorbs moisture because it is dry, on account of its temperature, and the moment you put it in contact with your condenser pipes you will take moisture out of it but you will also cool the air. Its dew-point has to go down to a low temperature before it could contain that moisture; and hence you have destroyed its ability to absorb moisture. It may be that the reason you had a greater efficiency was that you didn't have a proper circulation of air in the first place before adding the condenser.

MR. SPENCE—Have you on record the quickest time of drying a core 1½ inches in diameter, made in halves, 12 inches long, the quickest time that you know of one to be dried in?

MR LANE—I know of a case of a 1½-inch solid core that was dried satisfactorily in about 20 minutes. It was in an experiment.

MR. SPENCE—I just bought a core oven about three months ago made by the Roberts Portable Oven Co., in Chicago—steel inside and out, lined with asbestos and we dried the core above mentioned in four minutes.

THE PRESIDENT—I don't think, gentlemen, that that answers Mr. Cutter's question. He wanted to know if there were any one present in the room that was using a core oven equipped as he described. Mr. Lane, of course, took up the question of telling him the application of such a system of using a pipe or a cooling system.

I might say just one word in connection with this. The United States Steel Corporation has spent nearly half a million dollars, and there have been nearly fifty contributions in all the scientific papers for the last two and a half years on the several lines of freezing the moisture out of the atmosphere and

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the cost of producing a ton of pig iron down to about 30 per cent to 40 per cent for the fuel end on account of the freezing of the atmosphere and the condensing of the water out of it. They got down to a practical working basis on these lines, and I can say that by writing to Mr. Galey, vice-president of the United States Steel Corporation, he will furnish you data on freezing the moisture from the atmosphere before applying it in melting and drying.

MR. HOYT—What is the best or highest temperature for core ovens?

MR. LANE—The proper temperature for a core oven depends somewhat on the binder, but it varies between 350 degrees and 600 degrees. If you go above 600 degrees you get to a point where you would burn almost any binder. You get to a point where soft punk would take fire of itself, and you reach a point where you destroy the binding properties of anything in cores; but 500 degrees to 550 degrees Fahr. for a certain class of cores gives a very rapid baking temperature. The best range of temperatures varies between 350 degrees and 525 degrees Fahr. Experiments have been tried in several shops where they maintain their cores very close to 500 degrees.

THE SECRETARY—I made a number of experiments with large and small cores to find out what the binders would do. I first got my temperature to about 250 degrees Fahr. and dried the core, and then raised it to 350 degrees to bake it. I worked at about 350 degrees for the highest; 350 degrees Fahr. is about the maximum that you want. It always seemed to me that the process of making cores is divided into two parts—first, to dry, and then to bake.

MR. CUTTER—Has there been any experience along that line of the condenser to confirm or disprove the experience which we had? In the introduction of the condenser, I put it in on one side, of course arranged so the water would circulate vertically. I found on the opposite side of the core oven that we did not get as good results as we did on the side where the condenser was placed. It seemed not to be quite in accord with what Mr. Lane said, that the air would become chilled in coming in contact with the condenser. At the same time that the condenser was introduced into the oven, I increased the circulation; and we were able to cut the fuel from 25 per cent to 40 per cent. This was last fall, and immediately after the test was made the cold weather put our condenser for the time being out of commission, and I have not been able to make any further tests; but I wanted to know whether the economy in the fuel was due entirely to the condenser or to the increased air circulation in the oven, or both. I have felt this spring I would introduce a condenser of like capacity on the opposite side of the oven, inasmuch as we obtained so good results on the side on which the condenser was placed.

MR. LANE—I would like to see you try your oven some time without your condenser and with your increased and decreased drafts. That would give you one set of results; and then by testing with the condenser under both conditions you get the other set of results; in that way you would be able to prove or disprove the matter very nicely indeed. The conditions of a core oven are subject to so many variations that it is pretty difficult sometimes to tell just what it is that does it. If you change two variables at the same time you don't know what the results are. We should only change one variable at a time and see what the results are. I have seen some changes on the same principle that the Irishman changed the ware-drying room, by choking off the draft so as to keep the draft in.

MR. CUTTER—I wish to state that I am a layman and entirely green; and all this I am taking out of the virgin soil, as it were. I am just experimenting; because from the first I found that the fuel question was simply enormous and that the results obtained in getting the properly baked or dried cores was not satisfactory. I know that the condenser had been used in the drying of lumber and other things. It is not a new idea with me but in other industries the condenser had been used. Inasmuch as getting the moisture out of the cores was essential, I thought it at

least was worth trying; and the results were very satisfactory.

THE PRESIDENT—The fundamental principle of this association is education, and it is due to the fact that it is through experience, trials and mistakes that we are all making and comparing, that gives us the educational value. It is on the lines that if we hadn't made an attempt we would not have had the question discussed or argued at this meeting. It has brought up a new subject, that I think will be worthy of further discussion. The chair would not assume the authority of appointing a committee of one to keep on with the experiments and make a report; but he will see that the secretary does not forget it next year.

MR. BURR—As near as I can recollect now, the chimney in our core oven takes its draft from almost the level of the cores, and as far away as we can get. Our experience has been we could dry cores in almost any quantity with equal facility; and I think that we have beaten twenty minutes.

THE PRESIDENT—I think the present time would be a very opportune time to announce the nominating committee. The following gentlemen have been suggested to me by their respective districts:

Mr. J. S. Seaman, Pittsburg, chairman.
Mr. A. W. Walker, Boston.
Mr. Geo. Davies, Philadelphia.
Mr. Thcs. Sheriff, Milwaukee.
Mr. L. L. Anthes, Toronto, Can.

Meeting adjourned.

Smoker.

The record of the proceedings of the Philadelphia convention would not be complete without mention of the substantial expression of good will given the secretary during the smoker on Friday evening.

The surprise was complete, and quite overcame the secretary, who found it impossible to make any response. The valuable punch bowl with the inscription "Dr. Richard Moldenke—from the Foundrymen of America—1907," was a gift, coming from the entire foundry industry of the United States and Canada, such as is the lot of but few men to receive in this world, and the honor was deeply appreciated, in fact felt by the secretary to be far above his deserts. On the punch bowl also there was in ornamental execution in black and red enamel, the Prussian Coat of Arms of Dr. Moldenke's family, which dates back to the tenth century, to the time when the nobles of Brandenburg wrested the primeval forests of Poland from the occupants and brought enlightenment into those regions.

With the beautiful gift came the substantial and golden clinking of sixty pieces—twenties, which were given Dr. Moldenke in the course of a warm and heartfelt address by his friend and co-laborer in the realm of foundry science—Herbert E. Field, of Pittsburg. Of the results of this later, when a European trip shall have added to the fund of experience of the secretary, and the memory of the kindness and good will of his many friends who have combined to give such an exceptional honor and substantial remembrance will be with the recipient all his life, and in handing the magnificient punch bowl down to his children, may it serve as an incentive to them to constantly labor for the good of all while striving for legitimate self-advancement.

The smoker was a grand success, and everyone went home well satisfied with Philadelphia's bountiful courtesy, and the tactful arrangements of the committee.

Third Session, May 22, 2:30 p. m.

President McFadden after calling the meeting to order introduced Prof. Coggeshall, of Girard College, who was present with a number of his students to see the Exhibition.

PROF. THELWELL RUSSELL COGGESHALL—I had not expected to say a word. I came in as a guest, and brought several of our embryo mechanics with me; but I think we are doing good foundry work at Girard College. We have a very well equipped foundry. To be sure, our cupola won't run down many tons, as it has a diameter of only 22 inches, but we have a couple of crucible furnaces and keep them going all day and pour nearly every mold that we make, so as to prove our patterns. We usually make

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all the castings that we use in the institution.

We have 1,600 boys in the institution, 980 of whom go to the mechanical school. Last evening I read from your stage at Lulu Temple an invitation to Girard. This is a very excellent time to come and see Girard, because it has its Sunday clothes on. Last Monday was the founder's birthday and our young men have gathered together some of the work of the past year and it is now on exhibition for you to examine. It includes not only foundry work but blacksmithing, plumbing, machine and electrical appliances. There is also some very excellent pattern work, which I am sure every foundryman will appreciate; and I extend an invitation to every one.

THE PRESIDENT—Professor Stimpson will now talk on "The Training in Foundry Work, at Pratt Institute."

Prof. Wm. C. Stimpson then read his paper, p. 26 of the Transactions.

MR. KNICKERBACKER—It seems to me that the foundrymen of the country are not fully alive to their duties toward the apprentices that they have in their employ. Most of us have not time to go into the best methods by which to train those young men; and the result is, that we have no uniform system that we can follow. There has been established within the last year or two at Indianapolis the Winona Foundry School, whose object is to try and make molders so that the men can go out from that school into foundries and take up the work as journeymen. If that school could be used as headquarters for information in regard to training apprentices, and that information be disseminated throughout this entire country, including Canada, it would tend to put us in position where we would know better how to attack this problem. We have with us today Prof. Johnston, of the Winona School; and I would suggest that we ask Prof. Johnston to tell us what they are doing there, if it is in order.

THE PRESIDENT—We would like to have Prof. Johnston give us a talk.

PROF. A. E. JOHNSTON—Mr. Chairman, gentlemen—At Winona, Indianapolis, rather, the school is known as the Winona Technical Institute. This is essentially a trade school only. I want to outline to you the course that we have.

Our chief aim is to graduate from our school efficient men not only in a practical line of work, but also with enough technical knowledge to know the whys of foundry work. To this end we have arranged a course that we think in a short time will turn out men such as we wish. Our course is two years. The first year we teach fundamental principles—the elementary work, you might say; in the second year, the more advanced work in all lines. We take up molding in different branches, core making, cupola practice, iron mixtures, etc.

We have a course of foundry chemistry, also mechanical drawing. Our students work from 7 a. m. until 6:30 p. m. Six hours a week is devoted to chemistry; three hours a week to mechanical drawing; and the remaining number of hours to foundry work—actual shop practice. I will now show you a few lantern slides which illustrate our equipment and work, and later on will send your secretary a fuller description of our school in the form of a paper.

Prof. Johnston then exhibited a number of lantern slides, which were very much appreciated by the audience.

President McFadden next called upon Mr. H. F. J. Porter, the well known expert on industrial betterment, who in view of the advanced hour gave a brief talk on the subject of "Industrial Betterment," and passed a large number of interesting lantern slides over the screen rapidly talking on each as it went by. What was seen in the short time showed conclusively what great good could be accomplished by attention to this subject, and how direct results in dollars and cents were certain to follow the judicious establishment of betterments for the working classes engaged in our foundries and manufacturing plants. Mr. Porter read his other paper on "Cost Accounts" by title, and this appears in the Transactions on another page.

In connection with the subject, however, President McFadden called upon Mr. Jas. Stirling, secretary of the Jobbing Founders' Association, to explain what had been done by that Association

in the direction of a fundamental basis for shop cost accounts for foundry purposes.

JAMES S. STIRLING: I had rather expected Mr. Miles would appear for us this afternoon and outline some steps we had taken looking toward a uniform cost system for obtaining jobbing accounts. We all know the question of costs of our work is one of extreme interest to us.

I think it was about a month ago Mr. Miles and Mr. Johnston of the Braddock Machine Manufacturing Co., of Braddock, Pa., presented a paper before the Pittsburg Foundrymen's Association outlining just about what our organization has attempted to do. We went into the matter very thoroughly with an expert foundry cost accountant, and we came to certain conclusions. Those conclusions it is hardly necessary for me to bring out this afternoon; but I would like to refer you to those two addresses published in the trade papers at that time. You will get them in THE IRON TRADE REVIEW, THE FOUNDRY and the IRON AGE—quite a number of them; and we will present to this Association, Mr. President, what we have done originally for your proceedings. We dealt more particularly with the distribution of the burden for the overhead expenses. We found, when we called our preliminary meeting for our association, that it was a very rare thing to find any two jobbing foundries who were keeping their costs in exactly the same manner. We had some who were going on a productive hour basis and putting all their overhead charges on a productive hour basis, some on a tonnage basis, some on the productive wages basis, and some people, I think, were guessing—probably a great many of us are guessing to a certain extent. After studying the question as thoroughly as we could, for about a year, we came to the conclusion that the proper way to distribute our overhead expenses was to divide them between the tonnage basis and the productive hour's wages; and that is simply what we have accomplished so far.

We made up a set of forms which would carry the job when entered to the profit and loss department in the ledger; but those forms might not fit every concern, and we have simply brought down to a small statement of the various charges that we think should be divided, one to the tonnage basis, the other to the productive labor basis. They will appear in the copy of the Proceedings, showing exactly what there is, and each foundryman, of course, will get his details in whatever manner best suits his business. You have a committee on costs, Mr. President, and we will be very glad—the Jobbing Founders' Association—to be allowed to co-operate with you and get the good points you have. Ours is still in embryo; and while it is in operation in the two or three foundries, we would be very glad to find any weak points in our system to improve.

We believe it is a vital question to all of us when we go out into the market and find a casting some man has quoted 6c a pound on and some of us think it is a fair price and come back and find somebody else has taken it for 2¾c. I feel that somebody is guessing badly, or has estimated badly; and we want to arrive at some kind of system whereby a man might know, when he has made his estimate, that he has got all of the expenses pertaining to that job.

President McFadden then called upon Mr. Ronceray, who gave his highly interesting paper on the Universal Molding Machine which he is now introducing in this country. Also a paper on a new method of making molding sand. The first paper was illustrated by lantern slides, and the use of the cinematograph, which showed the making of a mold very naturally. Later Mr. Ronceray mixed some sand and clay into a molding sand in a most ingenious way with excellent results.

Meeting adjourned.

Fourth Session, May 23, 11 a. m.

VICE PRESIDENT CALEY—Mr. Seaman would like to make a few remarks.

MR. SEAMAN—Our worthy president met with an accident last night that prevents him from being here as chairman today, and will probably keep him out of commission for several weeks. He requested me to be here and make that statement and help out as far as possi-

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ble. In order to do that, I move you that Mr. Charles J. Caley, being first vice president, act as chairman of this meeting. (Carried.)

THE SECRETARY—Mr. Chairman, the first order of business will be a report in connection with the papers of yesterday on the trade schools and on the form of education. Mr. Kreutzpointner was here at the time and desired to make a motion; but it was too late. His idea seemed a good one, and I would like to present it herewith, also a resolution, to appoint a committee for getting closer relations between the schools (the educational system of the country in other words) and the shops: to try to begin to harmonize these various schools that are forming now for the education of foundrymen and getting them into some system. Mr. Kreutzpointner, if our chairman will make him head of that committee—will do all the work for us and report next year; so I present his motion that a committee be appointed to take up the question of the closer relations between the schools and the shops. Motion numerously seconded and carried.

THE SECRETARY—I beg to present Mr. Kreutzpointner's memorial for record and publication.

Mr. Kreutzpointner's Memorial.

President and Members of the American Foundrymen's Association—The importance assigned to the educational side of the foundry work and apprentices at this convention, encourages me to call attention to some points vitally affecting the present and future success of all these efforts along lines of proposed trade education, be this education for the foundry or any other trade or manufacture. And in the end the foundrymen cannot go ahead in the education for their trade without a corresponding cooperation and systematic, sympathetic movement of all the educational forces which shape every social and industrial condition all over the country. The necessities of the phenomenally rapid development of our industries has produced and is producing at an accelerated rate earnest attempts to meet their necessities, but these attempts are scattered and lacking that harmony of understanding for mutual needs which is necessary to produce the most effective and highly economic results with the least expenditure of time and energy.

The teachers of the country in their various associations are constantly, of late, discussing the need of industrial education, as I can testify from my own part in these discussions at the conventions of the National Educational Association, the Eastern Manual Training and Art Teachers' Association, the Pennsylvania State Educational Association, the Altoona Teachers' Association and the Philadelphia Educational Association. As further proof of the earnestness of the teachers in this important operation I mention the fact that at next month's annual convention of the National Educational convention a new department will be formed, the department of technical education in public schools. But the teachers are concerned with methods, and are not familiar with the practical needs of our industries, while on the other hand the practical men are not aware of these earnest but more or less theoretical efforts of the teachers. Since the American foundrymen have taken a leading position in the education of apprentices, I respectfully move that the American Foundrymen's Association appoint an educational committee for the purpose of uniting and harmonizing these scattered efforts of teachers and practical industrial men, not only for the benefit of the foundrymen, but for the good and welfare of the whole country. How to bring about the desired result I have not time now to explain. But the school must serve as a basis for all future educational efforts of our industries.

Teaching a young man to write essays before he has mastered the language he is using, is a very expensive way in the end.

Respectfully submitted,

P. KREUTZPOINTNER.

Mr. Sang, of Pittsburg, then gave an epitome of his highly important paper on the "Art of Galvanizing," which will be found in another part of the Trans-

actions. There was a short discussion and the nominating committee then reported as follows:

MR. SEAMAN —Your Nominating Committee met yesterday afternoon and nominated the following ticket:

For president, Stanley G. Flagg Jr.; first district vice president, C. J. Caley; second district, John W. Burr; third district, H. E. Field; fourth district, J. H. Whiting; fifth district, J. K. Beckwith; sixth district, T. W. Sheriff, seventh district, J. P. Golden; eighth district, L. L. Anthes. For secretary and treasurer, Richard Moldenke.

THE CHAIRMAN —Gentlemen, you have heard the report of the nominating committee; what action do you desire to take on it?

(Moved and seconded that the secretary cast one ballot for the nominations just read.)

(Carried.)

THE SECRETARY —The ballot is cast and the election concluded.

MR. SEAMAN —It is usually the case that we recognize the courtesy of the different cities where we have met by giving them a vote of thanks for what they have done for us. I wish to offer a resolution that a vote of thanks be tendered to the following organizations and persons: Philadelphia Foundrymen's Association, entertainment committee, the Supply Association, readers of papers, and all others who have helped to make the convention so pleasant and entertaining.

Seconded and carried.

MR. SEAMAN —There is another thing I wish to bring forward, one is that our worthy president, as is customary, be elected an honorary member of the American Foundrymen's Association. This has always been done, and I make a motion to that effect.

THE CHAIRMAN —Motion is made and seconded that the retiring president be made an honorary member of the American Foundrymen's Association. So voted.

MR. SEAMAN—Gentlemen, I have got another point I want to make and this is a very important one. I have been so fortunate or unfortunate as to be on the auditing committee of this organization. We have a secretary in the organization who has been giving us good and faithful service. Further than that, I want to say he has never been getting the salary that he should get, but, notwithstanding all that, he has paid his dues like a man. Now I propose to make our worthy secretary an honorary member of this association. (Carried.)

THE SECRETARY —You know your secretary is a little anxious always to look ahead. I went through the experience twice where we had no invitation at convention time, and it was a hard dig to get something moving. At Buffalo and New York we had no invitations and it was a little hard to get there, but we got there. We have now an invitation from Toronto, and we have also an invitation for the year following from Cincinnati. I have letters from the manufacturers' organizations in Canada, and I understand later on they will be supplemented by an official invitation from the head of the state so that it will be practically an international invitation to bring Canada and the United States closer. The idea was that we have a meeting in a Canadian town for a few days and then drift into Niagara Falls afterwards for the exhibition, because you see for yourself how it is to have the exhibition and the meeting hall right side by side. It is a terrible thing for the business of the association. I will say that I have official invitations from the highest people in Canada to come up there next year.

MR. ANTHES —About two years ago since I first proposed that the American Foundrymen's Association should hold one of their forthcoming conventions at Toronto. At that time we were having a convention in New York, and Cleveland was spoken of with Philadelphia for 1907; that coincided with my views, knowing that both Cleveland and Philadelphia had first choice, I put down Toronto for the next choice. Being a little bit on the outskirts I felt that we people over the line would like to benefit by what you good people had been doing over here in the steel and iron industries. Dr. Moldenke was the first man to interest me in the American Foundrymen's Association at the St.

Louis World's Fair several years ago. I at once became very much interested in the work that was being done; and I have been trying to interest my friends across the line so that we have made a fairly good showing at the convention this year. Two years ago I was the only Canadian present at the convention. Last year there were a dozen at Cleveland, and this year there are a hundred Canadians here. Next year we expect to have five or six hundred if we get you up there. Of course, we have not the enormous population to pull from that you have down here, but we are steadily growing. Our population does not grow so much by immigration as the population of the United States, but, as your good President Roosevelt would say, we have no race suicide up there. All good Canadians living up there are good Canadian stock ,and want to fraternize with the good brothers over the line; relations for the last forty or fifty years have been growing warmer and warmer; trade relations are growing closer, and many of our aspirations are very similar.

Canada is a great country, growing rapidly in the lines of iron and steel industries, and we want to get all the advantages we can in the scientific end of it. I feel there is no organization in the world has as high a position in the technical end of it as the American Foundrymen's Association.

We have a fine town in Toronto, noted all over America as one of the finest convention cities in the world. Of course, I am not in a position to speak of our European cities, not knowing much of them. However, I wish to state that I am delegated by the Canadian Manufacturers' Association, by the Local Foundrymen of Canada, by the Manufacturers' Association of Toronto, and the Mayor and Corporation, to extend to the American Foundrymen's Association a hearty invitation and welcome to spend their next annual convention in Toronto, Canada.

Unfortunately, the exhibition and the reading of papers come so closely together in a big building like this that the papers don't get just the attention that they should have. It has been said that it would be better to have the exhibition at one place and the convention in another. Well, I would rather see the whole thing come to Toronto, because we are in a position to handle any thing like that. We have an annual exposition there which takes in a great many exhibits from the United States; so that the laws have been so adjusted that there is no trouble in getting exhibits into the Toronto end of it. We have a big fair grounds, with buildings especially built for expositions of this kind; and we also have our auditorium there on the same grounds, within a stone's throw, for the reading of papers. We have a large theater there, built very much the same as the lecture rooms of a big college, and the facilities for the showing of lantern slides and illustrating any of the papers. However, so far as the exhibition is concerned, this rests more or less with the Supply Association, and I believe that is to be brought up this afternoon before them, at their session.

I will again say I heartily invite and welcome the American Foundrymen's Association to Toronto in 1908.

SAME MEMBER —I make a motion to meet in Toronto next year, subject to the approval of the Executive Board.

(Seconded.)

MR. SLY —I am a foundryman, also a supply man. We understood we would have a great deal of trouble in getting our exhibit over in to Canada, but our friend here says there will be none, and when it comes up for consideration before the Foundry Supply Association, I will vote that we have the whole exhibit over in Canada.

A MEMBER —I quite agree with the gentleman that made this last remark, that the two associations should hold their convention at the same place. I think it would be the sentiment of this association, and should oppose the holding of an exhibit in one city and the convention of this association in another city. I think that we ought to express that very tersely.

THE CHAIRMAN —I was wondering how it would be possible to take the machinery, etc., over the line without paying the 33 1-3 per cent.

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THE SECRETARY.—That really doesn't belong before this Association. The supply men, if they want to go to Canada, all right. If they don't want to, we can not make them. Our end of it is to hold a convention, if we wish, in Toronto. What is done about the exhibits is something the other Association has to act upon. Personally, I would like to see the meeting and the exhibit more separated.

A MEMBER.—With due respect to our worthy secretary, I think the relations existing between the associations would be of such a character that they ought to work with unison. If the Supply Men's Association can not go to Canada, it seems to me this Association ought not to take steps to go there. The exhibits are quite an important feature of the conventions of this Association.

THE SECRETARY.—Again, it may be that the association may suffer by having too much from the supply end. We will have to work that out the best way we can to harm neither association.

MR. SEAMAN.—I think this can be settled all right. Mr. Anthes says they have got all provisions to get our exhibits over here, and we have got our fairs here that bring their products over here. There is an arrangement between the governments for that, and as far as this is concerned here, I think this question of leaving this altogether in the hands of the executive committee, which is proper and right—we can declare our preference here. The supply people can do the same and leave the whole question in the hands of the executive committee and they will arrange that as they have done heretofore. I don't think there will be any question about our going to Canada. It seems to be the general opinion with everybody that they would like to go there the next time. I favor it myself, but I believe in leaving it in the hands of the executive committee, which consists of the president and vice presidents of the organization.

MR. SLY.—During my talk a little bit ago with the Cleveland people we got the report that if we carted our goods over there to make an exhibit, and then wanted to bring them back again, that it would take a year. The supply men thought that it would be better to hold the exhibition at Niagara Falls or Buffalo, and then go over in Canada. But our friend here from Canada tells us that he has a letter from the Canadian authorities saying that we can put our exhibits in bond and send them over there without any trouble or bother; and not only that, they go further and they say they will take all the trouble that may directly follow.

THE CHAIRMAN.—For the benefit of the executive committee and the members present, I would like to have Mr. Anthes say whether or how it would be possible to take the machinery, etc., over to Canada and bring it back again, without going through the red tape necessary in international affairs.

MR. ANTHES.—We have written the Minister of Customs and have a letter from him, from Ottawa, stating there will be no difficulty whatever in having the exhibit brought into Canada and taken away again. The exhibits will be admitted in bond and the place where the exhibits are to be held will be made a bonded warehouse for the time being. I might explain, in connection with our exposition there, that every year there is a large lot of American machinery and different exhibits going into Canada, and men are set apart to look after them, so that there is a regular system up there for bringing exhibits into Canada—especially into Toronto—for exhibition purposes only. The goods will come there in bond and will be held in bond, and any goods sold will be sold subject to the duty and be checked in bond and be checked out.

THE SECRETARY.—Now, Mr. Chairman, there is only one thing further; and that is, that Cincinnati, through the Mayor and the representatives of the Manufacturers' Association, would like to be on record for the convention to follow the next one. We have a very cordial invitation to go to Cincinnati in 1909.

Meeting adjourned.

The afternoon was spent in an agreeable boat ride to Washington Park where some 500 foundrymen sat down to an excellent shad dinner. Philadelphia is famous for this, and those who attended were not disappointed but voted the outing a huge success.

ANNUAL MEETING OF THE ASSOCIATED FOUNDRY FOREMEN

The fifth annual meeting of the Associated Foundry Foremen was held in the Manufacturers' Club, Philadelphia, on Monday evening, May 20. The attendance was large and the enthusiasm manifested was indicative of the interest that is being shown by the foremen and superintendents in this organization. The meeting was called to order by President W. H. McPhee, and after a few preliminary remarks as to the object of the association, an opportunity was given those who wished to join to make application for membership. After reading the minutes of the previous meeting, reports were presented from the following locals: Erie, Chicago, New York, Cleveland, Philadelphia, Hamilton, Ont., and Indianapolis. Considerable progress was reported by all these associations, but Milwaukee, Cincinnati and Montreal not being represented, no report was received. The annual report of the secretary, F. C. Everitt, showed an increase in membership of 36, making a total of 370. Despite these forward strides, the secretary said he regretted that insufficient interest is taken in this association by the foundrymen and their foremen. The secretary's report follows:

In presenting a brief report of the activities of the association for the fiscal year now about to close, we will note with much interest that our affairs are in a satisfactory condition and that the value of our organization is steadily increasing.

The association has materially increased in membership and to such an extent that we are able to report a total of 370 at the present time which is a net increase of 36 over the number reported a year ago.

The response of our members, in an effort to place themselves in better standing with the association, has been much greater up to the present time than has been the case for some years past. It is not to be inferred, however, nor must we be content to think that the above conditions are what we most desire.

Whether these encouraging conditions are the results brought about by the advent of the Foundry Supply Association, in which case the foremen and their employers have recognized the opportunity of accumulating valuable knowledge concerning the line of more modern foundry appliances which incidentally would be a source of much profit to them, or the recognition of the fact that the results of the work of these organizations are beginning to impress more thoroughly the subjects of advanced foundry practice in a light that appears at this time more profitable than ever, is a question that remains entirely with our judgment.

However, the value of the latter combined with the many valuable advantages presented by the former, we must all admit, provides a most economical course for education in the many branches of foundry science.

It is much to be regretted that more of the foundrymen and their foremen do not readily enter into this work and place their years of experience in the field that the know ledge in general on the foundry practice of this country might be broadened to a greater extent, and our foreman provided with a more complete course for study with the paramount idea of educating himself, not only from a practical standpoint, but this combined with enough of theory that he may more intelligently discuss and manage general shop affairs.

I do not here wish to be misunderstood in regard to the progress already made, for we all appreciate that

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during the eleven years since this work was begun by the American Foundrymen's Association this progress has been quite phenomenal and most thorough.

The amount of appreciation shown by the foundrymen and their foremen throughout the country, excepting, of course, those directly interested in these associations, for the enormous amount of tedious and careful investigating, to say nothing of the voluminous and far extending correspondence that has been necessary to bring about the present state of perfection of conditions in foundry practice is far below what might be expected in a country where so many economical educational advantages are accessible.

As has been the case in many lines of the engineering world, the results from these years of labor and investigation may in the near future, possibly not with this generation, but surely with the ones to come, be so adjusted as to provide a course of education that will be well within the means of any apprentice who is to be educated as the future foundry foremen and operator.

This is not a new adventure at the present time, for we have within our own association a member who is now conducting in the south an industrial school for the education of foundry apprentices. This particular case has come to our notice only within the last few months and it is to be hoped that we may learn more of this enterprise during the coming year, and if properly directed the desired foundry foremen will be the result.

Our association is yet in its infancy and to bring it to the state of perfection that is much desired by those who are most interested and appreciate fully the value and scope of the work that will be necessary, it will be a matter of the greatest importance for the affairs of the association to be conducted by those of our members who will be most considerate and diplomatic in their judgment, untiring in their efforts, most thorough in the execution of such investigations as may be placed in their care for disposal and display the most willing and patient disposition with an unlimited amount of courage which will overrule the many discouraging features that will constantly be encountered.

The object of our endeavors is the sole purpose of increasing our knowledge on general foundry practice, and with the hearty co-operation and consideration of our members, the efforts of our officers will in due time place our association, we hope, far beyond the desired state of perfection.

The individual cost of this co-operation and support is exceedingly small, but sufficient to carry our affairs in a satisfactory condition and provide additional amounts for experimenting and assisting the mother organization by carrying our share of the burden.

We sincerely trust that the increasing interest of our members will continue. The result can be no other than beneficial to us all.

The valuable support and assistance that we have received and which is always at our command through our good friend, Dr. Moldenke, is certainly greatly appreciated and we extend to him our hearty thanks.

The receipts and expenses for the year are as follows:

Cash on hand June 4, 1906	$106.80
Total receipts to May 20, 1907	304.27
Total expenditures	248.31
Balance May 20, 1907	$162.76

REPORT OF MEMBERSHIP.

Honorary members June 4, 1906	21
Active members June 4, 1906	313
Total	334
Honorary members May 20, 1907	23
Active members May 20, 1907	347
Died	1
Resigned	1
Dropped	2
Total membership	370
New members received	40
Net increase	36

Election of Officers.

After the report of the auditing committee, which showed the records and accounts to be in a very satisfactory condition, the nominating committee made its report and the following officers were elected: President,

Jas. F. Webb, L. S. & M. S. Ry., Elkhart, Ind.; first vice president, W. S. McQuillin, Allegheny Foundry Co., Warren, Pa.; second vice president, W. O. Steele, Bateman Mfg. Co., Grenloch, N. J.; secretary and treasurer, F. C. Everitt, J. L. Mott Co., Trenton, N. J. Under the constitution of the Associated Foundry Foremen the presidents of the local associations become vice presidents of the national organization. They are as follows: W. F. Grunau, Erie, Pa.; Thomas Glasscock, Milwaukee, Wis.; E. W. Smith, Chicago; Hugh McPhee, New York; W. A. Keller, Indianapolis; Hugh Mackenzie, Cleveland; W. A. Perrine, Philadelphia; David Reid, Hamilton, Ont., H. J. Holmes, Cincinnati.

Revision of Constitution and By-Laws.

Retiring President Hugh McPhee was elected to honorary membership. The method of electing officers aroused considerable discussion and it was the sense of the meeting that the opportunity be afforded each of the delegates to cast a ballot for any of the various aspirants, instead of having that power delegated to the secretary. A committee of five was appointed to revise the constitution and by-laws and was instructed to report at the next meeting. It is made up as follows: A. M. Loudon, W. A. Perrine, A. T. William, M. C. O'Connor and F. C. Everitt. The officers elected were then called upon for remarks and all asked for the co-operation of the members, that they might more efficiently execute the duties of their offices and be able to present reports of progress at the next meeting.

Special Meeting.

At a special meeting held at the Second Regiment Armory Wednesday evening, May 22, a plan for the circulation of papers read at the meetings of the various locals was discussed and adopted. The plan outlined includes the sending of all papers read at the local meetings to the secretary's office, where they will be compiled and printed in pamphlet form and later issued to all of the members of the association. Each local will receive copies which will serve to provide material for discussion at their meetings. Every effort will be made to make the plan effective and it is believed that the results will be beneficial.

A pleasant feature of the river trip to Washington park was the presentation of a diamond ring to F. C. Everitt, the efficient secretary of the Associated Foundry Foreman. The presentation speech was made by W. O. Steele, Grenloch, N. J.

ORGANIZATION OF THE AMERICAN BRASS FOUNDERS' ASSOCIATION

The American Brass Founders' Association was organized during the closing session of the American Foundrymen's Association in Philadelphia, on the morning of May 23. It is the intention to bring into this organization all industries whose products are made from non-ferrous metals. Those eligible to membership include not only proprietors but superintendents and foremen of brass foundries, and all connected with aluminum, copper and other works employing sheet metal, wire, or other forms of such metals apart from castings. Electro-plating interests are likewise included. The committee appointed on Tuesday with Dr. Moldenke as chairman reported a constitution and by-laws patterned closely after those of the American Foundrymen's Association. It was decided to call the new organization the American Brass Founders' Association, and while this name met with some objection from the aluminum and other interests, the difficulty of finding a name which would be all-inclusive was appreciated, as well as the fact that the brass founders had been the important factor in the promotion of the new association. The committee on nomination, composed of Palmer H. Langdon, of *Metal Industry,* New York; W. R. Webster, superintendent of the Bridgeport Brass Co., Bridgeport, Conn.; R. Marshall, of *Copper and Brass,* Detroit; A. A. Miller, of *The Iron Age,* Philadelphia; Chas. H. Proctor, of the F. H. Lovell Co., Arlington, N. J., and J. H. Webb, Elkhart, Ind., reported the following nominations, which were accepted without change:

President, Charles J. Caley, Russell & Erwin Mfg. Co., New Britain, Conn.

Secretary, Andrew M. Fairlie, Tennessee Copper Co., Copper Hill, Tenn.

Treasurer, J. H. Sheeler, The Sheeler-Hemsher Co., Philadelphia.

Vice presidents: For New England, W. R. Webster, Bridgeport Brass Co., Bridgeport, Conn., and W. S. Allen, Yale & Towne Mfg. Co., Stamford, Conn.; for New York and New Jersey, A. Bate, general superintendent Nathan Mfg. Co., New York City; Pennsylvania, Delaware, and Maryland, G. W. Wright, Reading Hardware Co., Reading, Pa.; central states, Wm. M. Corse, Detroit Lubricator Co., Detroit; western states, J. N. Gamble, general superintendent Western Tube Co., Kewanee, Ill.; southern states, Edro Richardson, the Edro Richardson Brass Co., Baltimore; Canada, left unfilled.

Brief remarks on the new association were made by Mr. Caley, Mr. Fairlie and Mr. Sheeler, and a number of applications for membership were taken. It was stated that the next meeting would be held at the same time and place as the American Foundrymen's Association, and the meeting was adjourned after voicing its thanks to Dr. Moldenke for his assistance in the work of organization.

Preliminary Meeting of Brass Interests.

The preliminary meeting of those allied with the brass foundry interests to consider the advisability of organizing an association was held on Wednesday morning, May 22. It was presided over by Chas. J. Caley, New Britain, Conn., who made a brief address on the purpose of the promoters of the new organization. In answering the question who are eligible to membership he mentioned brass foundrymen, rolling mills, platers, supply men, electric workers, and those identified with the automobile industry, in fact, any one directly or indi-

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rectly connected with the working of the non-ferrous metals or their alloys. The speaker said that great things have been accomplished in the brass foundry in the past twenty years. He directed attention to the oil melting furnace, which he said has become a factor and is making rapid strides, although its field thus far has been limited to heavy castings. It has not as yet been able to replace the pit furnaces for light castings, plain and ornamental, such as are used in builders' hardware, saddlery, etc. He added that the molding machine has not met with as much success in the brass foundry as it should, owing in part to the character of the work and the cost of making and mounting patterns. The inventor has a problem here in designing a machine in which a standard frame may be used, the frame to be so arranged that by a simple method any gated or loose patterns may be attached quickly and accurately. The speaker said he knew of a dozen firms with thousands of patterns in their vaults, who would be only too glad to install molding machines in their brass foundries if they could obtain results without going to the expense of regating their patterns, as is necessary with most of the present molding machines.

Continuing, Mr. Caley said: "Handling, as I have been, hundreds of tons of brass and bronze wrought metal, and knowing the difficulties I have, due to defects in metal, I believe that the rolling mills, have their own troubles, as well as the foundrymen and I believe in many ways they can be benefited by membership in our association. The automobile interests claim more than passing notice, on account of the many intricate castings employed, castings that must be accurate and so constructed that they will withstand the tensional and torsional strains to which they are subjected. To accomplish the results desired it is necessary that the foundryman making such castings has in his employ men with a thorough knowledge of the foundry business and its requirements, men familiar with coremaking as well as the mixing and melting of metals required in automobile work. Plumbing and steam fitting interests certainly come in for their share of our attention, as they have made wonderful strides in the past twenty years, when we consider the old plumbing and the up-to-date open plumbing, the making of which has caused a revolution in the art of making light, durable castings. The same is true of steam fittings, as many of the valves of today are cored, where years ago they were bored. Steam pressure has been raised without showing any bad effect, which would go to prove that an advance has been made in the manufacture of metals to the extent that the cored valve of today is lighter by one-third than the valve of years ago."

Mr. Caley was followed by Paul Kreutzpointner, Altoona, Pa.; Hugh McPhee, Bridgeport, Conn.; Edro Richardson, Baltimore, Md.; W. H. Parry, Brooklyn, N. Y.; J. M. Gamble, Kewanee, Ill.; J. H. Sheeler, Philadelphia; Chas. Thomann, Crosby Steam Gauge & Valve Co., Boston; G. W. Wright, Reading, Pa.; and Messrs. Thompson and Bellows, Bridgeport, Conn. All were of the opinion that an association devoted to brass founding and kindred interests would have an important field of endeavor and would result in great good to all connected with these industries.

The study of brass mixtures, it was stated, would in itself prove an important line of inquiry for the new association. The preparation of molds, particularly their gating, and the pouring of the metal of proper temperatures are matters which might be investigated and discussed with profit. Papers were read by Andrew M. Fairlie, Copper Hill, Tenn., on "Science Applied to the Brass Industry," and by Chas. H. Proctor, Arlington, N. J., on "Electro-deposition of Brass." The following papers were read by title: "A Plea for Healthful Condi-

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tions in the Brass Foundry," by W. B. Snow, Hyde Park, Mass.; "Notes on Brass Castings," by C. E. Johnson, Dorchester, Mass.; "Copper for the Brass Foundry," by F. L. Antisell, Perth Amboy, N. J.; and "A Few Denatured Brass Foundry Notes," by Wm. H. Parry, Brooklyn, N. Y.

ANNUAL MEETING AND EXPOSITION OF THE FOUNDRY SUPPLY ASSOCIATION

From the morning of May 20, until Friday night the Second Regiment Armory, Philadelphia, was converted into a model foundry, where practical demonstrations were made of the most modern appliances for foundry work. Molds of the most intricate sections were made on power machines and cores were dried in ovens installed in the armory.

Two large sand conveyors and mixers were shown in operation and the exhibits of sand shakers included types both air and electrically driven. Heavy power machines and brass furnaces were operated in a tent, erected in a lot adjoining the armory, and the display of French machines made by Ph. Bonvillain & E. Ronceray, Paris, attracted unusual attention. The exhibitors were unanimous in proclaiming this feature a pronounced success, many of them having sold sufficient equipment to more than defray their expenses. One builder of molding machines reported sales aggregating $6,000, while another manufacturer of foundry equipment disposed of three large cupolas. In the line of smaller supplies, the sales were heavy and the indications are that the next show of the Foundry Supply Association will be on a larger scale than heretofore attempted. Including the displays grouped in the various booths more than 70 concerns were represented.

Meeting of the Foundry Supply Association.

At the annual meeting of the Foundry Supply Association, held in the assembly room of the Armory on Friday morning, May 24, reports were presented by secretary H. M. Lane, and J. S. McCormick, treasurer. The total receipts for the year amounted to $5,948.50, in addition to which there was due from members, $1,445, making a total of $7,393.50. The expenses of the exhibit, it was stated, would approximate $6,500. From the treasurer's report it would seem that there will be a balance of something over $1,000 after the expenses of the meeting are paid. The increase in membership during the year was remarkable, 99 concerns now being enrolled. For his untiring efforts in behalf of the association, secretary H. M. Lane was tendered a hearty vote of thanks and his salary was increased from $500 to $1,000 a year.

Election of Officers.

The nominating committee, consisting of T. E. Malone, H. Y. Seidel, E. J. Woodison, C. S. MacNeal and A. O. Backert, then presented its report, and the following officers were unanimously elected: E. H. Mumford, the E. H. Mumford Co., Philadelphia, president; W. P. Shepard, Rogers, Brown & Co., Buffalo, first vice president; W. S. Quigley, Rockwell Engineering Co., New York, second vice president; H. R. Atwater, Osborn Mfg. Co., Cleveland, third vice president; William Chambers, Garden City Sand Co., Chicago, fourth vice president; H. M. Lane, Cleveland, secretary, and J. S. McCormick, J. S. McCormick Co., Pittsburg, treasurer. U. E. Kanavel, Interstate Sand Co., Cleveland, and E. J. Woodison, Detroit Foundry Supply Co., Detroit, were elected trustees to replace the two trustees whose terms expired

with this meeting. The number of trustees was also increased from six to nine, and W. J. Hamilton, Hamilton Facing Mill Co., Hamilton, Ont., was elected to a three-year term and F. N. Perkins, Arcade Mfg. Co., Freeport, Ill., and George Rayner, Carborundum Co., Niagara Falls, N. Y., were elected for two years.

The question of permitting manufacturers and supply dealers not members of the association to distribute printed matter and souvenirs in the convention hall was discussed at some length and it was decided to leave this matter entirely in the hands of the secretary. Other details, including the charging of a nominal admission fee to those not members of the American Foundrymen's Association and the allied organizations were also considered and left in the hands of the executive committee.

Representatives of the cities of Toronto and Niagara Falls extended invitations to the association to meet next year in their respective cities. The use of a hall at Niagara Falls absolutely free of charge was offered the association and a similar proposition was made by the city of Toronto. Inasmuch as the American Foundrymen's Association, selects the place of meeting, no action was taken beyond thanking the two cities for their kind invitations.

The Exhibits.

Including the displays grouped in the various booths, more than 70 concerns were represented, as follows:

ADDRESSOGRAPH CO., New York.—Display of rapid addressing machines.

AMERICAN FERROFIX BRAZING CO., Philadelphia.—The brazing of metals was shown by practical demonstrations, with the use of either illuminating gas or oil as fuel.

ARCADE MFG. CO., Freeport, Ill.—Three molding machines, two No. 1 and one No. 2, equipped with different styles of pattern plates, showing the different grades of work that these machines can handle successfully. This display also included an assortment of the different classes of work which have been turned out on these machines.

BERKSHIRE MFG. CO., Cleveland.—Two standard size Berkshire molding machines were shown in operation, molding radiators, hot water heaters, soil pipe, and fittings, and one freak plate was used containing a variety of patterns. Sand elevators, revolving screens, flasks, etc., were also shown.

BONVILLAIN, PH., & E., RONCERAY, Paris.—One R-3 swinging Universal machine; one R-3 swinging Universal hydraulic machine; one sand distributor; hydraulic accumulator, pump, templet cutting machine, and one A-6 molding machine, as well as other types of molding machines made by this concern.

BORGNER, CYRUS, Philadelphia.—This exhibit contained a full line of fire brick, clay retorts, and other refractory supplies for foundry use.

BROWN, EDWARD, & SON, Philadelphia.—Complete line of pyrometers for foundry use.

BUCH'S, A., SONS, Elizabethtown, Pa.—Catalogs and printed matter describing the gravity molding machines manufactured by the Mitchell-Parks Mfg. Co., St. Louis, were distributed at this booth. This company represents the Mitchell-Parks Mfg. Co. in the east.

CAMDEN COKE CO., Philadelphia.—Exhibit of coke manufactured by the Otto Hoffman by-product system.

CHICAGO PNEUMATIC TOOL CO., Chicago.—Full line of pneumatic riveters, drills, chippers, grinders, rammers, sand shakers, hoists, and air compressors, for foundry use.

CLEVELAND WIRE SPRING CO., Cleveland.—Full line of foundry barrels and steel foundry boxes.

COOPER-HEWITT ELECTRIC CO., New York.—Cooper-Hewitt light installation in the armory.

CORTLAND CORUNDUM WHEEL CO., Cortland, N. Y.—Corundum grinding wheels, and bricks. Two motor-driven grinders, fitted with suitable wheels for grinding cast iron and large and small tools and saws.

CRAMP, WILLIAM, SHIP & ENGINE BUILDING CO., Philadelphia.—Parsons' white brass and manganese bronze and a display of castings and ingot molds.

DAYTON PNEUMATIC TOOL CO., Dayton, O.—Pneumatic hammers, riveters, chippers, etc.

DETROIT FOUNDRY SUPPLY CO., Detroit.—Revolving sand sifters, Crandall cupolas, and air-cooled gagger board.

DIAMOND CLAMP & FLASK CO., Richmond, Ind.—Three core machines, including a No. 1 small machine for making small cores from 3-16 to ¾ inches, and a No. 2 machine for making cores from ¾ inch to 3 inches, with duplicates from ⅜ to 1 inch, the machine making two of the smaller sizes at one time. Another machine shown had a capacity for making 57 varieties of cores, feeding cores, stop-off cores, chambers, etc. Belt shifters and quarter angle couplings were also shown.

DIXON, JOS., CRUCIBLE CO., Jersey City, N. J.—At the four corners of this exhibit large retorts were placed containing potted plants. In the place of a railing, crucibles of different sizes were arranged with the largest ones in the centers, graduating to the smaller sizes toward the retorts. Old crucibles that had run 60, 70, and 80 heats in Steele-Harvey furnaces and in the ordinary pit furnaces were also shown and labeled. Crucible fixings, such as stoppers, nozzles, stirrers, etc., were displayed in a show case on a pedestal stand and in another show case were placed glass bottles containing graphite for facings, etc.

DOGGETT, STANLEY, New York.—Exhibit of Perfection parting compound, charcoal and soapstone facings.

DRUCKLIEB, C., New York.—Three sizes of injector sand blast apparatus, for cleaning castings and other work, manufactured by this company, as follows: 24 x 24 inches, with a capacity of 500 pounds of sand at one filling; 30 x 36 inches, with a capacity of 1,200 pounds of sand; 30 x 48 inches, with a capacity of 2,000 pounds of sand, and samples of hose nozzle holders, couplings, nozzles and other attachments for use with these machines.

ETTING, EDWARD J., Philadelphia.—The Etting No. 46 cupola, rumbling barrels, foundry ladles, and Dings electro-magnetic separators.

FALLS RIVET & MACHINE CO., Cuyahoga Falls, O.—Two Wadsworth improved core ovens, one shown in operation, and the other one loaded with cores, which permitted an examination of the shelves when full; five coremaking machines and special cores made on the Wadsworth improved core machine; one friction drive rumbling barrel; one gagger mold, with demonstration of the method by which the gaggers are cast.

FOUNDRY SPECIALTY CO., Cincinnati.—A complete line of compounds for partings and facings for brass and iron work, as well as Fluxine, a new metal cleaner which was recently placed on the market. Molds were made at this exhibit by an experienced molder and the use of various parting compounds and facings demonstrated.

FOX MACHINE CO., Grand Rapids, Mich.—Display of Universal Trimmers.

GARDEN CITY SAND CO., Chicago.—Samples of a complete line of molding sands, as well as E. L. cupola blocks.

GOLDSCHMIDT THERMIT CO., New York.—Various appliances for heating and purifying metals with demonstrations of welding and burning, pipe welding, and apparatus for welding by the use of thermit.

GUNN, RICHARDS & CO., New York and Montreal, Canada.—Production engineers and public accountants.

HANNA ENGINEERING WORKS, Chicago.—Air and electrically driven sand shakers, pneumatic punches and riveters.

HARRINGTON, EDWIN, SON & CO., Philadelphia.—Peerless hoists in various sizes and of various types.

HAWLEY DOWN DRAFT FURNACE CO., Chicago.—Schwartz metal melting furnaces.

HERMAN PNEUMATIC MACHINE CO., Zelienople, Pa.—Three different types of jarring molding machines.

HOERMANN, A. E., New York.—One 1,000-pound sand capacity Farnham sand blast machine and all sizes and types of Green chipping, calking, and riveting hammers; sand rammers, hose couplings, as well as photographs and illustrations of cranes, hoists, compressors, trolleys, etc.

HOLLAND LINSEED OIL CO., Chicago.—Pure Open Kettle boiled linseed oil and liquid core compounds, together with samples of large cores successfully made with these compounds.

KERR TURBINE CO., Wellsville, N. Y.—Turbine engine direct connected to a fan.

KEYSTONE GREASE CO., Philadelphia.—Greases and lubricants for all classes of machinery.

KILLING MOLDING MACHINE CO., Davenport, Ia.—Molding machines of the roll-over and straight draw type; roll-over drop machines; roll-out molding machines; stripping plate molding machines, and air, water or steam power driven sand sifters.

KOPPEL, ARTHUR, CO., New York.—Industrial railway, dump cars, portable tracks, switches and turntables.

LIBRARY BUREAU, New York.—Systematizing methods.

LINDSAY, W. W., & CO., Philadelphia.—Complete line of foundry chaplets and anchors made by this concern in all sizes to meet the varying requirements of the foundry trade.

LINK-BELT CO., Nicetown, Philadelphia.—Conveying machinery, reciprocating sand elevator and conveyor and Renold silent chain drive. Reciprocating sand elevator and conveyor was shown in operation.

MACPHAIL FLASK AND MACHINE CO., Chicago.—Taper snap flasks and jackets, steel bottom boards and other foundry supplies.

MILLS, C. E., OIL CO., Syracuse, N. Y.—Core compounds both liquid and dry. This exhibit was fenced in with the green barrels with yellow heads containing the compound manufactured by this company.

MITCHELL-PARKS MFG. CO. St. Louis.—In addition to its space in the Armory, this company exhibited its Gravity molding machine in the foundry of the Bernstein Mfg. Co., in Philadelphia. Automobiles operated between the Armory and the foundry, which carried visitors to the company's exhibit. Fifteen minute service was in effect for five days and hundreds availed themselves of the opportunity of seeing this machine in operation.

MONARCH EMERY & CORUNDUM WHEEL CO., Camden, N. J.—Full line of emery and corundum wheels and electrically driven grinders. An interesting feature of this exhibit was the practical demonstration of the use of an emery or corundum wheel shown in operation.

MONARCH ENGINEERING & MFG. CO., Baltimore, Md.—Monarch melting furnaces were shown in operation, as well as Monarch burners for core ovens and molds. This exhibit also contained a display of core ovens.

MUMFORD, E. H., CO., Philadelphia.—Molding machines plain power rammers, with match plates of both steel and aluminum; No. 2 Pridmore machine; No. 3 Pridmore machine with Mumford vibrator and frame; power ramming split pattern machine and a sand shaker with the Mumford loose rings adapted for supplying sand to molding machines.

McCORMICK, J. S., CO., Pittsburg.—Sand mixer with a capacity of 4 to 8 tons per hour; Farwell Universal molding machine; Reid molding machine; 20th Century molding machine and adjustable crucible tongs.

NEW ENGLAND ENGINEERING & EQUIPMENT CO., Boston.—This exhibit was made in connection with that of the W. W. Sly Mfg. Co., Cleveland, which this concern represents in the New England territory. It included electric and pneumatic cranes, hoists, cupolas, ladles, etc.

NORTHERN ENGINEERING WORKS, Detroit.—This exhibit consisted of one electric C type Northern chain block, with I-beam roller bearing trolley; one Champion No. 2 patent air hoist, 1-ton capacity; one geared crane ladle, with encased gearing, together with photographs of electric Northern cranes and foundry equipment, including a Newton cupola and Keep's sectional cupola.

OBERMAYER, S., CO., Cincinnati.—This booth was elaborately furnished with chairs, desks etc., and was provided with telephones and a stenographer for the use of the patrons and friends of the concern, where new acquaintances were accorded a cordial welcome by its host of representatives.

OLIVER MACHINERY CO., Grand Rapids, Mich.—Patternmakers' lathe, band saw, Universal saw bench and No. 3 trimmer.

OSBORN MFG. CO., Cleveland.—Complete line of foundry and factory supplies, such as shovels, riddles, wire brushes, both circular

and hand brushes, platers' brushes, heavy foundry brooms, and other miscellaneous foundry supplies. The exhibit consisted of two large pyramids, on which these goods were attractively displayed.

OTTO GAS ENGINE WORKS, Philadelphia.—Sixty-horsepower Otto gas engine, which operated a 45-kilowatt Crocker-Wheeler generator and furnished power for driving the working exhibits.

PANGBORN, THOMAS W., CO., New York.—Elaborate display of foundry equipment, which included the Pangborn sand blast machine; molding sands and clay products; Hammer core machines; Hanna pneumatic punches and riveters; air, steam and electrically driven sand shakers, and other foundry supplies.

PAXSON, J. W., CO., Philadelphia.—This exhibit was divided into four sections, the first containing the office. The second showed molding machines in operation, as well as centrifugal sand mixers and sand bins showing the various sands used in foundries in the eastern section of the country. In the third section the art of making sieves, bellows and brushes was shown and included a wire drawing machine and a large column on which was displayed the full line of brushes, sieves and bellows manufactured by this concern. The fourth section contained a display of the various types of brass melting furnaces, sprue cutters, skin drying stoves, magnetic separators, core ovens, tumbling barrels, and other small equipment for use in the foundry. In conjunction with this exhibit the Wilbraham-Green Blower Co. showed a blower in operation and a complete line of crucibles made by the Jos. Dixon Crucible Co. was also displayed. In the center of this exhibit a Paxson-Colliau cupola was shown surrounded by hay rope and ladle bowls.

PETTINOS BROS., Bethlehem, Pa.—This exhibit included the various products of this company's American and Mexican mines, consisting of lubricating and crucible flake graphites, foundry dust, blacking, etc., and the various grades of lump, chip and dust plumbago imported directly from the island of Ceylon, including the highest qualities for every purpose. Specimens of graphite ores taken from this company's numerous deposits were also displayed, as well as samples of its general line of facings, talcs and clays, molding sand and core gravels, and various articles of foundry equipment manufactured and handled by this concern.

PRIDMORE, HENRY E., Chicago.—Four molding machines, of the new style rock-over and drop types, were shown in operation. A stripping plate machine, 10 x 12 inches, was fitted with a set of standard M. C. B. brake shoe patterns.

PRIMOS CHEMICAL CO., Primos, Delaware county, Pa.—This exhibit contained a very complete display of ferro and other alloys.

RANDALL TRAMRAIL CO., Philadelphia.—Moyer system of overhead tramrail transmission was shown in operation.

RENDLE, ARTHUR E., New York.—Paradigm skylights, fireproof windows and sidelights.

ROBESON PROCESS CO., Camden, N. J.—This exhibit consisted of various barrels of Glutrin taken from the company's stock ready for shipment, which were arranged around the edge of this space instead of a railing. The booth was fitted up as an office for the accommodation of the company's patrons, and a stenographer was furnished for their exclusive use.

ROCKWELL ENGINEERING CO., New York.—Fuel oil burning appliances; double chamber Rockwell melting furnaces, and ladle heaters. Practical demonstrations were made of the operation of these furnaces.

SEIDEL, R. B., INC., Philadelphia.—Plumbago crucibles for melting all kinds of metals, special shapes, etc., manufactured by this company.

SLY, W. W. MFG. CO., Cleveland.—Core sand cleaner, dust arrester, resin grinders, exhaust tumbling barrels, and other foundry equipment.

SMITH, J. D., FOUNDRY SUPPLY CO., Cleveland.—Water tumbling barrels, sprue cutting machines, long bearing emery grinders, brass furnace, aluminum melting furnace, core oven car, ball bearing turntables, core oven, pneumatic sand sifter, and the Cleveland molding machine.

SMITH, SWOBODA & CO., New York.—Parting compound known by the trade name of Lycopart; samples were distributed and demonstrations were made showing the uses and advantages of this compound.

STANDARD SAND & MACHINE CO., Cleveland.—One No. 4 Standard continuous automatic sand mixing machine and a No. 2 pulverizer, which were erected in a self-contained frame, together with a feed hopper and elevator with a direct attachment of a 10-horsepower motor. The mixing plant had a capacity of from 15 to 18 tons per hour.

STURTEVANT, B. F., CO., Hyde Park, Mass.—Thirty-inch propeller fan; 7½-kilowatt generating set; No. 3 monogram exhaust fan; No. 9 steel pressure blower; working model of a high pressure blower; 30-inch steel plate mill exhaust fan; No. 9 direct connected high pressure blower; 18-inch disc fan, blast gates and other apparatus.

TABOR MFG. CO., Philadelphia.—Twenty-four-inch hinge molding machine with hand draft; 24-inch hinge machine with 7-inch hand draft and equalizer; 14 x 16-inch split pattern molding machine; 10, 13 and 15-inch power ramming machines, and a 36-inch Taylor-Newbold inserted tooth cold saw.

TAYLOR, J. L. MFG. CO., Bloomfield, N. J.—Quick adjusting and self-locking clamps.

UNITED STATES GRAPHITE CO., Saginaw, Mich.—Complete line of graphite products for foundry use.

WESTERN FOUNDRY SUPPLY CO., East St. Louis, Ill.—Lump ferro-manganese; ferro-silicon; ferro-chrome; ferro-nickel; oxide of chromium; oxide of manganese and foundry facings.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill. (Suburb of Chicago.)—This space was furnished with tables, chairs, desks, etc., where old friends were welcomed and new friends entertained. The booth contained framed photographs of foundry equipment manufactured by this company.

WILBRAHAM-GREEN BLOWER CO., Philadelphia.—Three motor driven foundry blowers, two of which were shown in operation; one was of an entirely new design, which embraced originally patented features not included in the present Green rotary pressure blower.

YALE & TOWNE MFG. CO., New York.—This exhibit contained a 2-ton portable electric hoist equipped with a "KY" type motor; a 2-ton portable electric foundry hoist, with a graduated speed controller for delicate foundry operations, and was equipped with a nominal 3-horsepower motor. This exhibit also contained one 20-ton triplex chain block which enables a single operator to lift a full 20-ton load at slow speed. Plain and geared steel trolleys for operating on bottom flanges of a single I-beam were also shown, as well as 1-ton triplex, duplex and differential chain blocks in operation under loads indicating the comparative efficiencies of the three types of chain blocks.

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CONVENTION ENROLLMENT—AMERICAN FOUNDRYMEN'S ASSOCIATION, PHILADELPHIA, MAY 21, 22, 23

ABELL, Ed. R., Haines, Jones & Cadbury Co., Philadelphia; N. Anderson, Camden, N. J.; L. R. Ashenfelter, Matthew Addy & Co., Pittsburg; Robert Adamson, Farrell Foundry & Machine Co., Ansonia, Conn.; J. A. Agnew, Dawes & Myler S. S. M. Co., New Brighton, Pa.; E. N. Anthony, Smith & Anthony Co., Boston, Mass.; Chas. G. Allen, Chas. G. Allen & Co., Barre, Mass.; E. R. Allen, E. R. Allen Foundry Co., Corning, N. Y.; Thos. N. Allen, Nelson Valve Co., Wyndmoor, Pa.; Gustavus Anderson, Harrison Safety Boiler Works, Philadelphia; D. E. Allen, Addressograph Co., Chicago; W. E. Arnold, L. R. Wister & Co., Philadelphia; Axel Anderson, Moline Plow Co., Moline, Ill.; A. C. Albrecht, North Bros. Mfg. Co., Philadelphia; Wm. Albrecht, Landers, Frary & Clark, New Britain, Conn.; Charles Alaud, Jas. B. Clow & Sons, Newcomerstown, O.; L. L. Anthes, Toronto Foundry Co., Ltd., Toronto, Can.; J. C. Armer, Editor *Canadian Machinery*, Toronto, Can.; J. L. Anthony, Weir Stove Co., Taunton, Mass.; M. Aikens, Berkshire Mfg. Co., Cleveland; T. A. Angell, Boynton Furnace Co., Jersey City, N. J.; Chas. L. Ackerson, Syracuse Aluminum & Bronze Co., Syracuse, N. Y.; S. W. Anness, Southern Machinery Co., Atlanta, Ga.; Robert Agnew, Canadian Locomotive Co., Kingston, Ont.; John Alexander, Harrison Safety Boiler Works, Philadelphia; Chas. W. Asbury, Enterprise Mfg. Co., Philadelphia; H. R. Atwater, Osborn Mfg. Co., Cleveland; H. N. Anderson, Cortland Corundum Wheel Co., Cortland, N. Y.; I. J. Allen, Demarest Mfg. Co., Williamsport, Pa.

BOWEN, J. J., Thomas W. Pangborn, New York; S. C. Bougher, J. W. Paxson Co., Philadelphia; Sherman Bougher, J. W. Paxson Co., Philadelphia; J. K. Bougher, J. W. Paxson Co., Philadelphia; Jonathan Bartley, Joseph Dixon Crucible Co., Jersey City, N. J.; Clarence R. Brown; E. E. Brown & Co., Philadelphia; H. G. Boughton, Standard Sand & Mach. Co., Cleveland; C. F. Battenfield, Berkshire Mfg. Co., Cleveland; I. C. Bovnton, Osborn Mfg. Co., Cleveland; J. N. Battenfield, Berkshire Mfg. Co., Cleveland; H. M. Bougher, J. W. Paxson Co., Philadelphia; T. Harold Brown, Buchanan Foundry Co., Lebanon, Pa.; T. I. Best, Best Steel Casting Co., Montreal, P. Q., Can.; Cyrus Borgner, Cyrus Borgner Co., Philadelphia; Elmer E. Brown, M. D., E. E. Brown & Co., Philadelphia; S. D. V. Burr, *Metal Industry*, New York; A. Bachman, Buckeye Foundry Co., Cincinnati; H. A. Busby, Keystone Lubricator Co., Philadelphia; Henry Barton, Henry E. Pridmore, Chicago; E. F. Burns, Otto Gas Engine Co., Philadelphia; David Black, Estate Stove Co., Hamilton, O.; W. H. S. Bateman, Philadelphia Pneumatic Tool Co., Philadelphia; H. F. Baldwin, Sullivan Machinery Co., Claremont, N. H.; A. O. Backert, editor THE FOUNDRY, Cleveland; William Blair, North & Judd Co., New Britain, Conn.; L. D. Beitzel, U. S. Arsenal, Watertown, Mass.; Wm. P. Bernstein, Bernstein Mfg. Co., Philadelphia; E. A. Bernstein, Bernstein Mfg. Co., Philadelphia; R. S. Buch, A. Buch's Sons Co., Elizabethtown, Pa.; J. H. Buch, A. Buch's Sons Co., Elizabethtown, Pa.; E. E. Breyer, Belknap Mfg. Co., Bridgeport, Conn.; W. L. Belknap, Belknap Mfg. Co., Bridgeport, Conn.; Geo. A. Burman, King Radiator Co., Toronto, Can.; John J. Bruce, John J. Bruce Foundry Co., Cincinnati; H. Black, Robert Field Co., Cincinnati; J. M. Betton, C. Drucklieb, New York; Clark Butts, Medina Foundry Co., Medina, N. Y.; Wm. Barsley, N. Y. Shipbuilding Co., Camden, N. J.; Frank S. Barnett, O. Barnett Foundry Co., Newark, N. J.; J. B. Bernhard, Garwood Foundry & Mach. Co., Garwood, N. J.; S. Roscoe Bateman, Bateman Mfg. Co., Grenloch, N. J.; J. Ross Bates, Whiting Foundry Equipment Co., Boston; H. W. Bullard, Poughkeepsie Foundry & Machine Co., Poughkeepsie, N. Y.; James Bradford, Lord & Berman Co., Evanton, N. Y.; M. H. Bickley, Penn Steel Casting Co., Chester, Pa.; Donald Brown, S. H. Barnum Co., New Haven, Conn.; J. B. Bonner, Carnegie Steel Co., Philadelphia; Jos. Bobenrieth, Theo. B. Rohrman, Philadelphia; David Bell, Dominion Coal Co., Glace Bay, N. S.; Geo. Benkert, Fairmount Foundry Co., Philadelphia; C. O'D. Blanchfield, *Industrial World*, Pittsburg; W. S. Bickley, Penna. Steel Casting & Machine Co., Chester, Pa.; J. M. Barron, Pulaski Iron Co., Philadelphia; G. C. Batten, J. B. Morris Foundry Co., Cincinnati; A. K. Beckwith, Estate of P. D. Beckwith, Inc., Dowagiac, Mich.; A. F. Beavens, Hancock Inspirator Co., Boston; H. W. Brown, Tabor Mfg. Co., Philadelphia; E. L. Binns, Superior Drill Co., Springfield, O.; F. M. Bedell, The S. C. Tatum Co., Cincinnati; J. H. Brooks, T. B. Harkins Foundry Co., Bristol, Pa.; M. B. Buckman Jr., Cooper Hewitt Elec. Co., Philadelphia; Cliff Bleyer, Hawley Down Draft Furnace Co., Chicago; W. R. Bean, T. H. Symington Co., Corning, N. Y.; W. J. J. Bowman, J. L. Mott Co., Trenton, N. J.; Wm. J. Brant, Miller's Product Co., Pittsburg; Henry D. Boyer, Keystone Foundry Co., Philadelphia; H. R. Barnhard, Lehigh Foundry Co., Fullarton, Pa.; I. C. Bannister, Western Tube Co., Kewanee, Ill.; J. J. Bever, Otis Steel Co., Cleveland; Harry L. Bell, Dodge Mfg. Co., Mishawaka, Ind.; J. W. Bumbaugh, National Tube Co., McKeesport, Pa.; E. C. Bailey, Milford Iron Co., Milford, Mass.; Chas. F. Brown, Utica Heater Co., Utica, N. Y.; I. W. Busch, Pratt & Cady Co., Hartford, Conn.; Wm. H. Baush, Confectioners' Machinery & Mfg. Co., Springfield Mass.; A. N. Bates, Erie Foundry Co., Erie, Pa.; James Bolland, E. W. Bliss Co., Brooklyn, N. Y.; Charles F. Bartlett, Philadelphia; James F. Brown, Mesta Machine Co., Pittsburg; C. L. Bell, C. L. Bell Co., Hillsboro, O.; Robert C. Bird, Broadway Iron Foundry Co., Cambridge, Mass.; William Blair, North & Judd Mfg. Co., New Britain, Conn.; Geo. Booker, Fort Pitt Malleable Co., Pittsburg; H. M. Brewster, Millett Core Oven Co., Springfield, Mass.; Chas. C. Bacon, Ross Tacony Crucible Co., Tacony, Philadelphia; James A. Beckett, Walter A. Wood M. & R. M. Co., Hoosick Falls, N. Y.; John W. Burr, Burnhouse & Co., Brooklyn, N. Y.; Fred Blundell, Taylor & Boggis Foundry Co., Cleveland; C. C. Boyden, Matthew Addy & Co., Philadelphia; M. J. Brennan, Brennan Sign Co., Tillytown, Pa.; F. C. Brooksbank, Tilghman-Brooksbank Sand Blast Co., Philadelphia; C. H. Bierbaum, Lumen Bearing Co.,

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Sauter, Rebman Iron Foundry, Philadelphia; A Schroeder, Schaum & Uhlinger, Philadelphia; F. E. Scoville, C. E. Mills Oil Co., Syracuse, N. Y.; Eliot A. Shaw, Walker & Pratt Mfg. Co., Watertown, Mass.; Bartlett M. Shaw, Walker & Pratt Mfg. Co., Watertown, Mass.; W. O. Shaw, Thos. Devlin Mfg. Co., Philadelphia; William Surdam, Frost & Wood, Smith Falls, Ont.; J. Willett Smith, Southern Machinery Co., Atlanta, Ga.; N. H. Schwenck, Wm. Cramp & Sons, Philadelphia; William A. Smith, Atlas Brass Foundry, Brooklyn, N. Y.; Bert S. Stephenson, Penton Publishing Co., New York; Edward M. Stradley, Edward M. Stradley & Co., Philadelphia; G. Smerling, General Electric Co., Lynn, Mass.; Walter M. Saunders, A. Carpenter & Sons Foundry Co., Providence, R. I.; L. Silverter, J. Wesley Pullman, Philadelphia; C. R. Spare, Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia; J. A. Thorn, Joliet Stove Works, Joliet, Ill.; R. H. Snider, Barwood & Snider, Philadelphia; Henry W. Stauffer, Harshey Machine & Foundry Co., Manheim, Pa.; J. L. G. Sully, Raymond Mfg. Co., Guelph, Ont.; Clarence E. Seitzinger, J. J. Black, Erie, Pa.; F. M. Staples, McFarland Foundry & Machine Co., Trenton, N. J.; F. G. Stewart, B. F. Sturtevant Co., Hyde Park, Mass.; T. W. Shepard, Reading Stove Co., Reading, Pa.; William A. Smith, Atlas Brass Foundry, Brooklyn, N. Y.; Ernest Stutz, Goldschmidt Thermit Co., New York; M. A. Scholes, Thos. Devlin Mfg. Co., Philadelphia; W. A. Speakman, Speakman Supply & Pipe Co., Wilmington, Del.; Christian Scheel, Globe Malleable Iron Co., Syracuse, N. Y.; John Schmidt, C. Hitzeroth Co., Philadelphia; W. E. Swanga, American Saw Mill Machinery Co., Hackettstown, N. J.; Geo. Schow, The Fox Machine Co., Grand Rapids, Mich.; W. J. Somerset, E. Harrington & Son, Philadelphia; F. H. Schutz, H. Mueller Mfg. Co., Decatur, Ill.; J. S. Seaman, Seaman, Sleeth Co., Pittsburg, Pa.; J. S. Seaman Jr., Seaman, Sleeth Co., Pittsburg; G. E. Sharp, Ohio Foundry Co., Steubenville, O.; David Spence, L. F. Fales Foundry Co., Franklin, Mass.; D. E. Spielman, Penna. R. R. Co., Altoona, Pa.; Luther Shick, I. A. Shepherd Co., Philadelphia; A. Shuman, J. L. Mott Co., Trenton, N. J.; T. W. Sheriffs, Sheriffs Mfg. Co., Milwaukee; S. F. Smyth, Smyth, Swoboda & Co., New York; J. D. Stoddard, Detroit Testing Laboratory, Detroit; Wm. Seidler, Jaracki Mfg. Co., Erie, Pa.; C. C. Swift, City Foundry Co., Cleveland; J. W. Seymour, Southern Machinery Co., New York; Gus Slusser, Westinghouse Foundry Co., Trafford City, Pa.; W. C. Sly, W. W. Sly Mfg. Co., Cleveland; Roger Sherron, E. Harrington & Sons, Philadelphia; Lewis S. Sprinkle, Cahill Iron Works, Chattanooga, Tenn.; E. F. Sullivan, Standard Foundry Co., Hartford, Conn.; L. H. Swind, Becker-Brainard Milling Machine Co., Hyde Park, Mass.; Otto W. Schaum, Schaum & Uhlinger, Philadelphia; W. E. Smith, U. S. Navy Dept., Midvale Steel Co., Philadelphia; W. W. Sly, W. W. Sly Mfg. Co., Cleveland; Horace Y. Seidel, R. B. Seidel, Inc., Philadelphia; Edwin Seedhouse, Falls Rivet & Machine Co., Cuyahoga Falls, O.; H. L. Swarzenberg, *American Metal Market*, New York; J. S. Smith, J. D. Smith Foundry Supply Co., Cleveland; P. J. Sweeney, Rockwell Engineering Co., New York; Wm. F. Sauter, Williamson Bros. Co., Philadelphia; Jas. S. Stirling Hilles & Jones Co., Wilmington, Del.; Franklin C. Sheppard, I. A. Sheppard & Co., Philadelphia; J. H. Sheeler, Sheeler, Hemsher Co., Philadelphia; William O. Steele, Bateman Mfg. Co., Grenloch, N. J.; Geo. R. Sullivan, Rogers, Brown & Co., Philadelphia; W. L. Schroeder, Arthur Koppel Co., New York; H. H. Stone, Penna. R. R. Co., Altoona, Pa.; J. E. Snyder, B. F. Sturtevant Co., Hyde Park, Mass.; F. Schwab, Gleason Works, Rochester, N. Y.; D. R. Steele, Monarch Engineering & Mfg. Co., Baltimore; A. Simonson, Philadelphia; F. C. Severin, Philadelphia Pneumatic Tool Co., Philadelphia; Thomas G. Smith, Midvale Steel Co., Philadelphia; W. H. Smith, Cleveland; F. H. Stoneman, Wortman & Warden Mfg. Co., London, Ont.; J. R. Schurz, Camden Coke Co., Camden, N. J.; Chas. W. Summerfield, Merchants' & Travelers' Association, Philadelphia; H. Linton Smith, Wm. Sellers, Philadelphia; P. J. Sullivan, Aluminum & Bronze Co., Syracuse, N. Y.; R. W. Stratton, Richmond, Ind.; P. H. Schaberg, Wm. R. Martin, Lancaster, Pa.; W. W. Shafer, Hermance Machine Co., Williamsport, Pa.; Henry Spilker, Sterrit & Thomas, Pittsburg; E. W. Sprague, Lehigh Foundry Co., Allentown, Pa.; Robert Savill, Thomas Savill & Sons, Philadelphia.

TAYLOR, Wm. E., Taylor & Co., Brooklyn, N. Y.; Joseph A. Taylor, New Lebanon Iron Foundry, Port Chester, N. Y.; G. S. Trubell, Empire Mfg. Co., London, Ont.; Edgar A Tooley, Mitchell Co., Cape May, N. J.; R. E. Turnbull, Chicago; Chas. Thomann, Crosby Steam Gauge & Valve Co., Boston; G. Trull, Ontario Malleable Iron Co., Oshawa, Can.; Geo. E. Tyson, Reading Hardware Co., Reading, Pa.; F. D. Taggart, United Engineering & Foundry Co., Youngstown, O.; F. M. Taylor, Lirary Bureau, New York; W. B. Traylor, Davey Bros., Goldsboro, N. C.; W. D. Trabue, Phillips & Buttorff Mfg. Co., Nashville, Tenn.; G. H. Thornton, Carondelet Foundry Co., St. Louis; Chas. L. Taylor, Phoenix Iron Works Co., Hartford, Conn.; H. A. Tinkham, White, Warner Co., Taunton, Mass.; A. A. Tanner, Waterbury Foundry Co., Waterbury, Conn.; D. J. Thomas, Sterrit Thomas Foundry Co., Pittsburg; Harris Tabor, Tabor Mfg. Co., Philadelphia; H. B.

Taylor Jr., Pettinos Bros., Philadelphia; John Thomas, Yale & Towne Mfg. Co., Stamford, Conn.; Clarence Tolan Jr., Matthew Addy & Co., Philadelphia; Isaac Trolley, Adriance, Platt & Co., Poughkeepsie, N. Y.; Jas. B. Taylor, Wm. Wharton Jr., & Co., Philadelphia; David J. Thomas, Eynon-Evans Co., Philadelphia; Jas. L. Taylor, Jas. L. Taylor Mfg. Co., Bloomfield, N. J.; Justin Thorner, The S. Obermayer Co., Cincinnati; Wm. D. Taylor, Philadelphia; B. H. Tripp, Chicago Pneumatic Tool Co., Philadelphia; Samuel Terrell, Raymond Mfg. Co., Guelph, Ont.; C. Edw. A. Thompson, Bridgeport Deoxidized Bronze & Metal Co., Bridgeport, Conn.; M. H. Treadwell, Stoever Foundry & Mfg. Co., New York; Robert C. Tolmie, Lobdell Car Wheel Co., Wilmington, Del.; C. L. Tittle, C. L. Tittle Foundry, Blairsville, Pa.; Scott Thomas, J. W. Paxson Co., Philadelphia; R. B. Thompson, Abendroth Bros., Port Chester, N. Y.; Cyrus D. Tatman, Fairbanks Co., Philadelphia; Edw. Taggert, J. W. Paxson Co., Philadelphia; Josiah Thompson, J. Thompson & Co., Philadelphia; Edw. C. Thompson, J. Thompson & Co., Philadelphia; H. L. Tripple, The Fairbanks Co., Philadelphia; W. J. Thomson, Hamilton Facing Mill Co., Ltd., Hamilton, Ont.; H. V. Tyrrell, *Canadian Machinery & Mfg. News*, Toronto, Can.; J. S. Taylor, Paris Plow Co., Paris, Ont.; A. N. Thompson, Link-Belt Co., Chicago; U. Taylor, Robert Taylor & Son, Paterson, N. J.; G. M. Thrasher Jr., Western Tube Co., Kewanee, Ill.; A. H. Tallman, J. N. Tallman & Sons, Hamilton, Can.; James H. Tuttle, S. Cheney & Son, Manlius, N. Y.; A. Tropenas, Paris, France.

VEBER, H. M., Westinghouse Foundry Co., Pittsburg; Wm. Vanderman, Vanderman Plumbing & Heating Co., Willimantic, Conn.; J. S. Van Cleve, Erie Foundry Co., Erie, Pa.; James E. Vanderhoef, Sibley Foundry, Cornell University, Ithaca, N. Y.; H. S. Valentine, Yale & Towne Mfg. Co., New York.

WOOD, W. S., Cutter, Wood & Stevens Co., Boston; Henry Walker, Buckeye Foundry Co., Cincinnati; A. H. Warner, E. Stebbins Mfg. Co., Springfield, Mass.; M. K. Weigel, Killing Molding Machine Co., Davenport, Ia.; J. B. Walton, McClary Mfg. Co., London, Ont.; D. C. Wilson, M. W. Kellogg Mfg. Co., Newark, N. J.; George F. Wiesing, Sayre Stamping Co., Sayre, Pa.; P. Will, Sill Stove Works, Rochester, N. Y.; A. T. Williams, Enterprise Mfg. Co., Philadelphia; Wm. H. Wood, Penna. R. R. Co., Allegheny, Pa.; W. D. Wesson, Walworth Mfg. Co., Boston; E. J. Woodison, Detroit Foundry Supply Co., Detroit; C. A. West, Mitchell-Parks Mfg. Co., St. Louis; D. C. Warren, THE FOUNDRY, New York; A. T. Whiting, Whiting Foundry Equipment Co., Harvey, Ill.; J. P. Winlock, Barbour-Stockwell Co., Cambridge, Mass.; Arthur W. White, George White Sons Co., London, Ont.; I. I. Wells, Floyd Wells Co., Royersford, Pa.; Philip E. Wright, Thomas Iron Co., Philadelphia; W. M. Wright, Thomas Iron Co., Philadelphia; W. H. Wright, Thomas Iron Co., Philadelphia; J. M. Woolson, S. H. Barnum, New Haven, Conn.; Geo. H. Weaver, Dominion Foundry Supply Co., Montreal, Can.; Richard J. Wood, Abram Cox Stove Co., Lansdale, Pa.; W. J. Wagner, Manning, Maxwell & Moore, Philadelphia; L. B. Whitney, Monarch Emery & Corundum Wheel Co., Camden, N. J.; Geo. L. Wodey, Sam'l L. Moore Corp., Elizabeth, N. J.; Mark L. C. Wilde, Ernest Law Co., Philadelphia; Thomas Ward, Pittsburg Brass Mfg. Co., Pittsburg; W. R. Webster, Bridgeport Brass Co., Bridgeport, Conn.; V. L. Whitehead, Whitehead Bros. Co., Buffalo; Bert Weiss, Bethlehem Foundry & Machine Co., Bethlehem, Pa.; Geo. P. Walker, Whitehead Bros. Co., New York; E. M. Wightman, North & Judd Mfg. Co., New Britain, Conn.; B. F. Wallace, Stanley Doggett, New York; F. H. Wilmott, Capitol Foundry Co., Hartford, Conn.; M. D. Waldson, Utica Heater Co., Utica, N. Y.; James F. Webb, L. S. & M. S. Ry. Co., Elkhart, Ind.; W. B. Wolfendale, Nelson Valve Co., Wyndmoor, Pa.; Sam Wilkinson, Abendroth & Root Mfg. Co., Newburg, N. Y.; Geo. Webb, E. R. Allen Foundry Co., Corning, N. Y.; P. M. Wooden, Reeves & Co.'s Foundry, Columbus, Ind.; R. Walker, T. Shriver & Co., Harrison, N. J.; Geo. G. Wilson, Taylor Forbes Co., Guelph, Ont.; Thomas D. West, Thomas D. West Foundry Co., Sharpsville, Pa.; John F. Whitehead, Standard Sanitary Mfg. Co., New Brighton, Pa.; E. E. Warner, White-Warner Co., Taunton, Mass.; Chas. W. Winder, Clum & Atkinson, Rochester, N. Y.; Geo. R. Walker, J. Thompson Co., Philadelphia; H. E. Walters, United Engineering Co., Pittsburg; M. W. Woodburn, Ober Mfg. Co., Chagrin Falls, O.; Geo. Wait, Ober Mfg. Co., Chagrin Falls, O.; W. S. White, J. S. White Co., Pawtucket, R. I.; Harry G. Walton, Lehigh Foundry Co., New York; Arthur W. Walker, Walker & Pratt Mfg. Co., Boston; W. C. Wright, Rensselaer Mfg. Co., Troy, N. Y.; Geo. D. Wilkinson, Northwestern Malleable Iron Co., Milwaukee; A. G. Warner, J. W. Paxson Co., Philadelphia; George H. Wadsworth, Falls Rivet & Machine Co., Cuyahoga Falls, O.; Geo. H. Wadsworth Jr., Falls Rivet & Machine Co., Cuyahoga Falls, O.; S. B. Wills, E. E. Brown Co., Lebanon, Pa.; J. R. Webster, C. E. Mills Oil Co., Syracuse, N. Y.; Walter Wood, R. D. Wood & Co., Philadelphia; C. J. Wiltshire, General Electric Co., Schenectady, N. Y.; Chas. Weihe, Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.; Isaac Wood, U. S. Graphite Co., Saginaw, Mich.; T. H. Williams, U. S. Graphite Co., Saginaw, Mich.; W. Fred Wood, N. Y. Air Brake Co., Watertown, N. Y.; J. T. Whitehouse, Bonney-Floyd Co., Columbus, O.; S. E. Winslow, Ashcroft Mfg. Co., Bridgeport, Conn.; F. E. Wheeler, International Heater Co., Utica, N. Y.; A. H. Warner, Millett Core Oven Co., Springfield, Mass.; A. Weston, Vickers Sons & Maxim, Ltd., Barrow-in-Furness, England.

YAGLE, Wm., Yagle Foundry & Machine Co., Pittsburg; James Young, Penna. R. R. Co., Altoona, Pa.; R. H. York, Berkshire Mfg. Co., Cleveland; Henry W. Yost, Thomas Roberts Stevenson Co., Philadelphia; Wm. Yellowley, Canadian Locomotive Co., Kingston, Ont.

ZWING, E. M., E. H. Mumford Co., Philadelphia; O. Zentgraf, South Baltimore Steel Car & Foundry Co., Baltimore; Henry H. Zilm, Underwriters' Association, Philadelphia; F. H. Zimmers, Union Foundry & Machine Co., Pittsburg.

AMERICAN SOCIETY,
NOV 12 1907
OF CIVIL ENGINEERS,
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CURRENT FOUNDRY TOPICS

BY THE SECRETARY

The Production of Molders.

A very difficult subject to deal with, as there are so many sides to it. It is pretty generally agreed upon that we must devise ways and means to turn out a greatly increased supply of molders for the future, and do that quickly. But just how to go about this. In a few thousand shops there are made annually one or two molders apiece. In a few hundred shops perhaps ten or so apiece. Many of the recruits never advance beyond the stage of "handymen," and either remain where they are as good harmless citizens, valuable to the foundry in which they were raised; or else travel about and give their subsequent employers "experiences." The others, who really have something in them, get or ought to get the "Wanderlust" and go out to see the foundry world, work in the best shops they can find, and gradually perfect themselves in the gentle art of molding. These men become highly prized acquisitions; but the winnowing of the chaff, or shall we say the survival of the fittest, leaves but a few hundred valuable, of the thousands who were originally graduated into industrial life.

A few of our larger establishments have recognized this situation, and go about the training of young men into molders systematically. As the methods thus employed work themselves out, we will learn their educational value, as well as see in what ways improvement is possible. Foundry Trade Schools and other courses of instruction will add their quota, and so it will be seen that at last a small beginning has been made to grapple with a burning question.

As said above, there are so many sides to the matter. The large shop which trains men, likes to keep them at jobs which will give the quickest cash returns. Hence good men will go. The small shops cannot afford high wages for the average young molder. Hence they lose him also. Where then is the incentive to act as a philanthropist, and train young men for the benefit of others who do not lend a helping hand. Hence should foundrymen protect themselves with agreements carrying low wages and a high bonus at the end of the stipulated term? Again, have most foundries the variety of work an apprentice should have to properly acquire his art? Or have they the foreman or instructor who will give his time and experience to a good cause? How many molders, or foremen at that, are there today, who will give a boy more than a bare chance to learn his trade? But why multiply the points. The millenium is still far off.

American men who have pondered deeply over these things, and who have seen much of life, are beginning to realize that much of the labor involved in training apprentices in the foundry in order to furnish a stock of future molders, should be borne by the common school, yes even the home. The average American boy is a born mechanic, but he seldom has his natural gifts in that direction properly developed. The writer once served on his local school board, and took pains to familiarize himself with the practical value to the community of the three R's as taught in the little school-houses

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at the cross-roads in the farming districts of his State. He helped to inaugurate a Kindergarten in one school a mile and a half from his home, and at that time sent his two little boys there daily. These two American boys had had the run of the tool shed, nail box, etc., ever since they were big enough to walk, and if a wood-chisel was afterwards found badly nicked, or a good piece of board filled with nails, it was charged to profit and loss in the development of their inventive and mechanical faculties. It was interesting to note the mental progress of these boys after they had attended the Kindergarten a while. The nails were now driven into boards into geometric figures, and after their hides (the boys') had been warmed sufficiently on occasion, the good boards were left alone and scrap substituted. But now appeared fearfully and wonderfully constructed bridges over little brooks, the joints of pin construction, and they could stand a load. This shows that the mechanical turn to a boy's mind can nicely be brought out by proper instruction, even in play, and today these two shavers, respectively eight and ten years old, help their father in his experimental foundry in the cellar, keeping the bot-sticks primed, skimming the ladles, watching the power, and they do not get rattled when some metal slops over on a wet concrete floor.

Our American boy wants as much of this as he can get without interfering with the necessary studies. So that when it comes to the parting of the ways, the parent, teacher, and indeed he himself, may know pretty well what he is best fit for, and thus some of his best years are saved, getting into his life work quicker, and better.

Germany and France, more especially of European countries, have long ago mastered this phase of the educational problem. Perhaps our strenuous life, not shared in Europe to a very great extent, has prevented us from recognizing this as much as we ought. Our good friend Andrew Carnegie rightly said that only the progressive individual of a family emigrated to this country. The others stayed at home. Yet these stay-at-homes, properly trained, turn out most excellent work. And indeed what profits it to turn out a hundred molds here, forty of which are not perfect, when sixty perfect ones are made in the same time by men who know how over there. Now why cannot we be thorough and also fast. The way lies ahead of us, and we might as well face the music. The average American casting, though of good quality would not be accepted readily in Germany simply on account of its surface blemishes. If we could ship castings as such in competition into the interior of Europe we would soon learn this. You will seldom find American engineers in the drafting rooms detailing the great sky-scrapers or bridges. The painstaking German or Scandinavian is eagerly sought to do what the American is too impatient for.

It would be idle to moralize, without indicating some possible solution for the problem of our future molders. First of all it is necessary to educate our public school teachers up to a thorough comprehension of the fact that boys who are not to go to College should have some kind of an industrial education given them, the first step toward which is the already partially introduced system of manual training. Teachers, as well as parents must be brought to realize that only by united effort and advancement in industrial lines will our material welfare be retained and extended. Teachers of

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drawing and manual training should discard their present exalted tendencies, and come a little away from idealism and æstheticism, in order that their work may serve some industrial pursuit.

Item one, therefore, prepare the teachers of the country in this direction, if benefit is to follow. Item two. Encourage legislation tending to create or take over existing industrial school, as has been done by Wisconsin and Massachusetts.

We respectfully urge this upon the newly formed National Society for the Advancement of Industrial Education, as their proper field of activity. We foundrymen, brick-makers, plumbers, etc., will be glad to follow up such public school training and can do so much more easily and effectively, and therefore will turn out more useful citizens.

The recent German Commission, visiting America to study our school system, has made many recommendations taken from our practice, but a little sting was left at the end of the honey-bee report, when it is said "But for the want of trade high-schools, the American public school system might be called perfect." This gives the case in a nut shell.

Our German Friends.

The German Foundrymen's Association publish their Transactions in the form of Monthly Bulletins which contain important articles bearing on the industrial problems and conditions of the Empire as well as on the foreign markets. We are pleased to read a very kind notice of our recent Convention as well as an expression of the friendly relations existing between the two National bodies. Foundrymen are brothers-in-trouble the world over, and the experience and cooperation of our American foundrymen is freely offered our European brethren at all times. Whether in England, Germany, or France, nothing but the most cordial friendship and spirit exists between us, for all are learning and contributing to the industrial welfare of the world.

The above has not been written to emphasize the friendly relation of our foundrymen internationally, for there is quite a different feeling growing up here when it comes to other German industrial and political bodies. Only recently a very prominent German publication contained a series of articles the author of which quietly gives extracts of an American book, and tells the readers that with this it will not be necessary to purchase it. Incidentally facts are twisted, and remonstrance from here remains unanswered. Talk about pirates.

Now to be a little plainer. For more than thirty years we have let a steady stream of German Engineers visit our industrial establishments, coming with note book, foot rule, and sometimes a brazen assurance. They have carried away tons of blue prints generously given them, and when our American manufacturers go abroad, occasionally a Board of Directors' meeting has to be called before admission is officially—refused. This office has had sent to it European visitors by the score with the strongest letters from the other side. While always trying to oblige the gentlemen, it has now come to the point that unless a promise is given to reciprocate, credentials from this office to American Foundries are refused.

Strange, is it not, that it is a commonly accepted fact in America that it is impossible, or nearly so, to obtain a German patent on any invention of special merit. And yet one should not

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look for Japanese methods in Germany.

We turn again to our German foundry friends and gladly state that no such tendencies have ever cropped up in our long experience here and in their country.

The Heated Mixture for the Foundry.

One of the radical differences between European and American Cupola practice is the general use of the forehearth on the other side. The European founder prefers to set his tuyeres low down, leave a large opening for the flow of iron into the forehearth, which is partially heated by the blast from the cupola. The stream of metal therefore, once begun, does not cease until the wind is off, or the heat ended. The forehearth, which is practically a stationary bull-ladle, is tapped in place of the cupola itself. The result is a good mixture, as sufficient iron is always kept in the basin, but the metal must suffer slightly in regard to temperature.

The attention of our American foundrymen has of late been directed to the question of heated mixers for the foundry. The papers of Mr. J. B. Nau have given considerable information in this line, and being of a tilting type and heated very highly, these mixers are ideal for the foundries where the tonnage is large enough to warrant the expense.

The thought naturally comes to one as to how this excellent method could be made available for the smaller foundry, which has all the difficulties of the large foundry regarding lack of fluidity in the iron, and a few more besides. There is but one place where melting is done in the cupola, and that is in the melting zone above the tuyeres. Everywhere else it is colder, even in the bottom which is filled with incandescent coke. Where iron as free from sulphur as possible is demanded; as for instance light castings to be machined, it is customary to tap quite frequently, in fact almost let the stream run continuously, with the obvious disadvantage of improperly mixed iron. Were it possible to use a mixing basin, kept very hot, and which could be tilted without interfering with the cupola, it would fill a long felt want. So far trials have always been made with oil, but with little encouragement for the iron foundry. A proper arrangement to heat the mixer independently, might help to solve the problem and less attention would be required in charging in the first place. Where, as in the very large foundries, charging is now occasionally done automatically, this is a desideratum.

We therefore commend the idea to our inventors, who if they could devise an apparatus filling the above requirements would find a profitable field in American foundry practice.

REVIEWS.

Foundry Statistics.

The Iron Age. June 13th, gives an able editorial in which the figures for the foundry industry are summarized and show up in a truly formidable array. It seems that our foundry industry in its relation to the rest of the iron interests is a vastly more formidable factor here than in Germany or England. In 1905 German iron foundries used 2,433,910 tons of pig iron, and produced 2,202,611 tons of castings. In 1906 the British consumption of iron in its foundries amounted to 1,116,192 tons. Making due allowance for scrap, the approximate output of our foundries is 6,500,000 tons for 1906. The editorial concludes with the following: "It is only in keeping, therefore, with the growing importance of the industry, that the movement for

the advance of foundry practice has assumed a new dignity. It is not too much to say that the educational work has been a large factor in results commonly received as purely commercial."

Production of Zinc and Brass in the United States.

The Metal Industry. July. Mr. Andrew M. Fairlie, Secretary of the American Brass Founders' Association, in an article on the production of zinc in the United States, gives among other data, a complete list of the companies producing zinc. He estimates the production of new brass for 1906 at 171,000 short tons, as against 156,000 for 1905. Inasmuch as enormous tonnages of soft brass are melted each year, the figures really showing the extent of the brass industry should give the tonnage output of the brass foundries all told. Mr. Fairlie states that an effort will be made to do this for 1907, and predicts that this will give the Brass Foundry its proper rank in the galaxy of American manufactures.

German Foundry Foremen's Association.

The several local societies of foundry foremen existing in the East, West and middle Germany, as well as the large number of foremen in Germany not heretofore affiliated with any society, have joined the North German Association, and at the recent convention in Hanover, the name of the organization was changed to the "German Foundry Foremen's Association. Thus our American Foremen's Association now has a friendly rival in Europe. The chairman of the organization is Mr. H. Meier, Waldstrasse, 17, Hanover, Germany.

An Ancient Brass Working Family

The Ironmonger, Aug. 10th. Next year Herr Emil Schleicher, of the firm Mattheu Louis Schleicher's Sohn, of Stolberg, Rheinish-Prussia, will celebrate the 333 anniversary of the establishment of the firm. It was founded in 1575, by his lineal ancestors. The Schleichers lived in the Palatinate back in the 12th Century where they had already engaged in brass founding. Not only have all the male Schleichers of successive generations been brass founders, but they have been allied by marriage with all the principal brass manufacturing establishments of Dinant in Belgium. The firm has always worked in harmony with its employees and supported Building and Provident Societies within the works. On the occasion of the 330th anniversary, the head of the firm presented $250 each to two men, whose father, grandfather, and great-grandfather had successively worked for the firm for 150 years. Is it possible for us in America to even conceive of such Arcadian industrial happiness as this?

The Training of Foundry Apprentices.

The Foundry. Aug. describes the course of practical training which apprentices are put through at the works of the Ingersoll-Rand Co., at Phillipsburg, N. J. The plan was originally outlined by Mr. Philip C. Smith, and has been in operation practically unchanged for eleven years. The foundry is a very large one and one in which intricate molding and core work is executed. The young apprentice is first put into the core department and for a few weeks performs only the light duties, assisting the boy who has been there some three months. The latter, in turn, works with the boy who has had the advantage of six months' training. In this way, under the eye of the foreman in charge, the first of the four years' course is spent. His pay is now raised from one dollar to one dollar and twenty-five cents a day, and he goes three or four weeks with the melter, learning all the details of cupola practice. This really means that every molder in the shop eventually can run the cupola if necessary.

The training in the core room is very thorough, and when molding is taken up, he does not act as a helper, thus being left to ordinary labor, but molds at once. First simple work, and then more and more intricate jobs are made, as time passes. With the third year the daily wages of the boy go up to $1.75. During the third year, the

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boy gets the work he is best fitted for, and in the fourth year he is classed as a regular molder and paid accordingly. Any boy who does not make good is dropped, after having been given a reasonable opportunity. No agreements are made with the boy or parents, and he is governed by the regular shop rules.

Overhead Tramrails for the Foundry.

The Foundry. Oct. "Few labor-saving devices have been introduced into American Foundries in recent years that can compare with the overhead tram rail as a cost-reducing factor." This opening sentence in an article by Mr. A. W. Moyer will be cheerfully substantiated by every foundryman who has his knowldege at first hand. Being overhead it is out of the way, switches and turnouts allow the load to be brought to any part of the shop covered by this system. Loads up to 1,500 and 2,000 lbs. can be easily handled by one man.

Beginning with the yard, a ton of metal may be carried directly to some section of a rail provided with a lifting device, to hoist it up to the charging platform. To take off the melted iron as wanted from the cupola, a rail is looped around the front of the cupola, suitable branches allowing every floor to be served. The large quantity of iron carried allows the iron to remain hotter than when transported in the small hand ladle. The molder is not tired out and time is saved all around. Consequently the cost of production is cut considerably.

Castings when shaken out of the sand can be transported to the rolling room by overhead rail, and dumped directly into the barrels. Similarly thence to the grinding room. Then for galvanizing, if this is to be done. The core room can be served, and even sand taken from the sheds and brought to the foundry floors. It is simply a question of adapting the receptacle for the required purpose.

It is very important to lay out the system so that no two carriages meet when in transit. This would be serious in the case of ladles of molten iron. The rail section should be of a kind not to allow dust to collect and interfere with smooth running. Switches should always be locked automatically, and open ends protected by stops.

As an interesting summary of loads, we have the following: A man can trundle 300 lbs. in a barrow. On a wooden or cement floor, with a modern truck he can fetch 1,000 lbs. On a foundry floor 500 lbs. Industrial railway, 1,000 lbs., and overhead tramrail, 2,000 lbs. All of which shows a good chance for profits by this installation.

Testing Iron for Castings.

The Foundry. Oct. Prof. Bradley Stoughton, of Columbia University, contributes an exceptionally well written article on the above subject. First describing the cupola itself, and discussing the crucible zone, tuyere zone, melting zone and stack, he goes into the reasons for good and bad melting, based on the charges placed in the cupola. He emphasizes what every foundryman should know, that every cupola requires a study of its special conditions so that changes may be made until the best results are obtined from the melt. Among other things in this connection is the design of the cupola, the action of the melting zone, as seen on the lining after the drop, the way the air enters and whether you get great volume with low pressure or vica versa. Prof. Stoughton next gives mixture calculation based upon the changes occuring during a melt. Finally Mr. R. S. McQuillan's recent paper read before our Association is discussed, the table presented being peculiarly interesting in showing up the actual result of poor and good practice, all the details of cupola and melt being given for a number of shops. The article is well worth studying by our foundrymen, being a very clear exposition of the art in simple language. We understand that it forms a chapter in a book soon to be issued.

Wisconsin and the Trade Schools

Pittsburg Dispatch. Much attention is being directed to the recent act of the Wisconsin Legislature in taking over the Milwaukee School of Trades,

as part of the educational system of the State. As a consequence, requests for copies of the law under which this was done are very much in demand. Briefly stated, the law authorizes a tax of not over half a mill on the assessed valuation of a city, upon requisition of the School Board, this tax to be for trade school purposes only. The law further calls for the appointment of an Advisory Committee of five citizens, not members of the Board, but experienced in one or more of the trades to be taught, this committee to have the same power as the regular Board.

In view of the value derived from such Advisory Boards, as seen by the work accomplished by the Government Advisory Board on Fuel Tests, etc., the new departure of Wisconsin must redound to the benefit of the State. It is only through Trade Schools, based on Manual Training in the schools, that we can hope to retain our commercial supremacy, especially as against Germany. As Herr Ullmann, a prominent School Councillor of Germany aptly puts it: "Our boys cannot all become professional men. Many branches of commerce and industry are now so specialized, that trade schools are an absolute necessity. Unless we provide these, our common schools will turn out a lot of idlers and persons who have no future before them."

FROM COMMITTEE ON INDUSTRIAL EDUCATION.

By Paul Krenzpointner, Altoona, Pa., Chairman.

During the past ten years the interest of our industries in the training of young people for vocational life has been growing in proportion to the need for greater efficiency everywhere. Our industries especially are feeling the need of greater numbers of better trained men and the question of how to procure an adequate supply and how to train them has become a serious one.

The Foundrymen in particular have been foremost for a number of years in trying to find a solution for this problem, with but limited success thus far.

Here and there a way out of the difficulty has been sought at great cost by establishing apprentice schools in shops, under the supervision of some specially designated person, or, as is the case at Altoona, where the industrial department of the public High School was fully equipped at the expense of the Pennsylvania Railroad Company with a smith shop, a wood working and machine shop, a foundry and a drawing room.

However, only the wealthiest concerns can afford the luxury of a private school. The great mass of our industries depend for whatever little training apprentices and journeymen get, outside their shop work, upon evening schools, correspondence schools, and other, more or less, unsatisfactory means of instruction. The efforts made by the foundrymen to induce colleges to take up the training for the foundry do not meet the necessities of the case, in as much as a college course would train a few superintendents but leaves out of consideration the great and urgent need for trained foremen and workers.

But all these tentative attempts made thus far, by whatever source, form or method, to provide some kind of training for apprentices and an adequate supply of skilled and efficient industrial workers, are handicapped by the total absence in our educational system of a preparatory education which would serve as a basis upon which to build a satisfactory vocational education.

An education is needed which would serve all the purposes of a preparatory training for industrial work for those who do not wish to go higher in their school studies, and yet be no hindrance, but rather an advantage for those who wish to enter the high school or some other higher branches of learning.

All schools who now educate for industrial life, be they private shop apprentice schools, manual training high schools, or similar schools, feel the lack of such preparation on the part of their pupils and as a consequence lose valuable time by being obliged to do primary work where the teaching should be advanced, and to that extent impair the effectiveness of the special school. It is an economic and pedagogic waste to be obliged to teach in a finishing school what should have been taught in a preparatory school.

What may be called a preparatory training for vocational life we have an example of in the eighth grade or grammar grade, course of the public schools of Munich, Germany, where the pupils receive thirteen hours industrial education per week. Four hours drawing, one hour working drawings, four hours shop work, two hours chemistry and two hours physics per week give an excellent foundation to build upon for vocational life of whatever kind.

And because of the absence of any kind of preparatory training neither the foundrymen nor other industries will accomplish much of permanent value along lines of trade training unless the industries get into touch with the schools. The industries and the schools, by co-operation and studying each other's needs and peculiarities gain mutual strength and advantages. At first sight it would seem that manual training, now being rapidly introduced into our schools everywhere, would serve as the desired preparation upon which to build a comprehensive national industrial education.

However, as much good as manual training has done thus far and will do still more good in the future in counteracting the narrowing tendencies of a purely intellectual school education, manual training is not looked upon by the professional pedagogue as anything else than an experiment to replace in the school room those beneficial educational intellectual effects which were lost to our youth by the growth of our cities, by the displacement, by machinery and mechanical appliances of most of the various forms of manual activity and mental energy on the farm and in the household. These exerted an even more powerful educational influence than the little schooling the children received in those days.

In the mind of the pedagogue therefore, manual training simply serves as a supplementary function to broaden the intellectual effects of the literary studies of the schoolroom and shapes the methods of teaching manual training according to the needs and conveniences of the pedagogic necessities of the school room. Whatever benefits our industries may derive from it are mostly unintentional and incidental. Here and there we find a consciousness on the part of some teachers to have manual training also serve as the foundation for vocational life, but even so, without the earnest help of the industries, these good intentions are opposed by difficulties not easily to be overcome by a few far seeing educators.

Nor is it easy to devise a plan whereby the social as well as the pedagogic difficulties in the way of harmonious relations between the school and industries can be overcome. If the foundries were the predominant industry of a city then they might do as Fitchburg, Mass., is doing, experimentally, where the boys, wishing to go to work in the machine tool industries, are retained at school, learning the rudiments of the trade and at the same time continuing their academic studies. Then, when applying for apprenticeships in one or the other of the concerns, they are given credit for whatever advancement they had made towards trade training. Thus the school becomes a real preparatory course instead of the boy rushing into the factory at fourteen years of age to earn a few dollars, forget what little knowledge he had acquired and then in later years painfully and laboriously learn in evening schools, in an unsatisfactory way, what he ought to have learned when 14 and 15 years of age.

Such a plan, however, can be carried out only under exceptional circumstances. Foundries are not numerous enough in any one place to profit by a

similar plan. Trade schools are not looked upon favorably by the public, partly because of the expense connected with their establishment and partly because it is assumed that trade education is a matter to be attended to by the industries involved.

It is safe to say that, whatever trade schools may be established in the near future by municipalities and supported by public taxation, these will be for the building trades only.

The educational efforts of the foundry industry, and all other industries for that matter, as a necessary act of self preservation, must therefore be directed, first to the creation of a strong sentiment amongst the public at large for the necessity of industrial education. Second, to cause the universal introduction into our public and high schools of manual training and domestic science schools. Third, to see to it that this manual training be not confined to mere training in manual dexterity, as is mostly the case now in our manual training schools, but that manual training be made more technical, more scientific in scope. Fourth, to bring pressure to bear upon the legislatures of the various states to pass laws favoring the establishment of industrial schools similar to the laws of Massachusetts and Wisconsin. Fifth, to endorse and support the resolution passed by the Department of Superintendents of the National Educational Association at the meeting at Louisville in 1906 which reads as follows: "Resolved, That, since it is essential to the teaching of industrial subjects in the public schools that teachers shall first be trained for this work, we urge the state normal schools to give special attention to instruction in elementary agriculture, manual training and domestic science." Sixth, to bend every energy to create favorable public opinion for raising the salaries of teachers sufficiently high, and to provide funds for pensioning them, so as to attract the best talent to the schoolroom and to retain that talent when once acquired.

The underlying reasons for the carrying out these six point may be summed up briefly as follows:

First. Favorable public opinion is essential for the creation and support of such measures which require the expenditure of public money.

Second. No one industry, or group of industries, depending for their very existence upon the activity and prosperity upon all other industries, can advance much, if any, faster educationally than all the other industries are advancing. Hence, measures, tending to the educational advancement of a group of industries, if dependent upon some form of public education in whole or in part, must be made universal in their effects.

Third. The increasing use of machinery and mechanical appliances to lessen human toil is impossible without the careful study of the forces of nature and the properties of the materials used in construction. Hence modern industrial education not only demands manual dexterity in handling tools and using materials, but knowledge of the primary principles of mechanics and of science and the technical knowledge how to apply these principles economically. Thus manual training in our public schools, in order not only to meet the ever increasing demands for greater individual efficiency in vocational life but also to meet the complex demands of citizenship and civilization, should be broadened and deepened by the study of the nature of raw materials used, details of processes of production and manufacture, questions of transportation, commerce, export, import, adulterations, competition with foreign countries, etc. The commercial policy of a country, the problems of transportation, the effect of our scientific and technical knowledge upon the economic and social government, the social questions of state, municipal and national government, the interdependence of all professional, commercial, and industrial occupations of their own weal and woe from the weal and woe of all others, the influences of corporations, associations and labor unions upon social and political relations are all questions affecting alike the citizen and the industrial worker.

Fourth. To this end legislation should foster and encourage public

opinion in the establishment of industrial schools not only in industrial cities but rural communities.

Fifth. The resolution by the Department of Superintendents of the National Educational Association goes to the root of the matter of industrial education in as much as the better class of teachers of the future must come from our normal schools and colleges and without well trained teachers there can be no efficient education of any kind.

Sixth. The social position and salaries of teachers has not been and is not now, with the exception of few localities, sufficient to hold our best teachers in the public schools. Hence there is a constant change, about twenty-five per cent of the teachers leaving the schoolroom annually to get married or finding more remunerative employment, leaving the old and experienced ones mostly to meet the demand for increasingly efficient work in our schools.

As the Massachusetts Industrial Commission rightly says in its report, "Industrial and technical education cannot be considered apart from the general system of education out of which it must grow, and of which, if it is to be successful, it must form an integral part."

That this is being recognized is shown by the action of the Society for the Promotion of Engineering Education at its recent annual meeting when it was decided to invite the mining, mechanical, civil and electrical engineers for co-operative action to introduce the teaching of elementary technical subjects in our schools.

With a good working foundation laid in our schools, the special training needed for the foundry, or any other industry, is, considering the native intelligence of our youth, a comparatively easy matter. The difficulties, however, to be overcome in adjusting our educational system along such new lines of work are quite formidable and not easy to be overcome.

The historic development and organization of our educational system is not well adapted to have industrial education ingrafted upon it, the tradition of the schoolroom is unfriendly towards it since industrial education is considered lacking in cultural value our normal schools have thus far paid little or no attention to economic and industrial education in training of teachers. Industrial education, to be permanently valuable, is expensive, hence an ever welcome bone of contention for the politician and demagogue, and the poor pay and insecure position of teachers is an obstacle to secure and hold the best teaching talent.

This is the situation the foundrymen and all other industries and business interests of our country have to meet and with hearty co-operation and confidence of the members of the American Foundrymen's Association and allied interests your committee on Industrial education will try to promote the educational requirements of the foundry and to show that technical education and industrial training is not only a valuable investment by the taxpayer but has cultural value of a high order.

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VANADIUM IN CAST IRON

By DR. RICHARD MOLDENKE, Watchung, N. J.

For a number of years admirable reports on Alloys Research have come from Europe, and among them one would occasionally see mention of Vanadium and its remarkable effect on steel. The practical steel-maker, however, knowing the high price of this rare metal could only regret that Vanadium had no commercial application.

Since the discovery recently of enormous deposits of Vanadium, more particularly those in Colorado, matters have assumed a different shape. Prof. Hildebrand, of the U. S. Geological Survey, first located a deposit of Vanadiferous sandstone in that State, and this is now being worked extensively, and the ferro-alloy made right in this country. The supply of Vanadium is practically unlimited.

The properties of Vanadium Steel are as follows:—The elastic limit is increased without an impairment of the ductility of the steel. That is, an exceedingly strong steel is obtained with its softness still remaining. Coupled with these most valuable properties is another, and that is the extreme resistance to deterioration when the metal is subjected to severe and continued strains in service. It is non-fatiguing, and therefore an ideal rail road and rolling mill metal.

It is but natural that attention should be drawn to this new candidate for metallurgic favor for foundry use. The very first casting which might be benefited is the car wheel. Next the various kinds of rolls; then alkali pots, pump parts, etc. Anywhere, where strains are heavy and oft repeated, either direct tension and compression alternately, shock, or great variations in temperature.

In order to learn something of the effects of Vanadium on Cast Iron, a

series of tests was conducted, using melted scrapped car wheels for white iron, and a good machinery pig iron for a variety of gray iron. A ferro-vanadium carrying high carbon was selected because it melted at a lower temperature, and would also be cheaper for the foundryman. Varying proportions were added to the ladle full of molten metal, first in lump form, and as this did not give satisfaction with the small quantities of iron used at a time, the alloy was powdered before using.

Inasmuch as Vanadium, besides being a great strengthner, is also a powerful deoxidizing agent, and the increase in strength obtained by its use might be attributed to the purification of the iron only; a further series of tests was included in which the ladle was first treated with 80 per cent. ferromanganese in sufficient quantity to add 0.5 of manganese, and then the ferro-

FIG. 1—MOLDS

vanadium. In order to obtain some light on the deoxidizing power of vanadium, a set of tests was also made with burnt metal, the results of which are given in the tables below.

The test bars were of the regulation kind, as prescribed by the American Society for testing Materials, namely 1¼" round, cast on end, and

in dried molds. At first the molds were rammed up in the usual way in snap-flasks, and the shells arranged to allow setting up and pouring the molds on end. The slightly varying diameters of the bars resulting, however, brought about a better method. Fairly heavy perforated metal sheets were cut to size and riveted up as shown in the illustration. A bottom provided in similar manner. A little sand rammed in the bottom, the pattern placed, rammed up, and withdrawn by a spiral upward movement. The molds were then baked and afterwards poured. Striking the mold would drop the sand and test bar

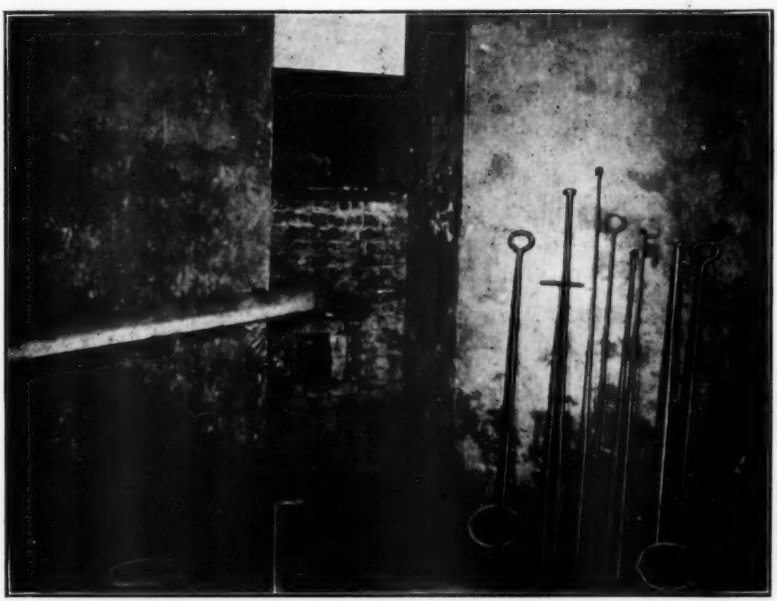

FIG. 2—CUPOLA

out, and another mold could then be made. Some forty of these perforated flasks were rammed up and dried for every run, and things went very smoothly.

The cupola was a small one, specially made for the tests, 22 inches inside the lining, and built into a corner tower of the writer's Castle. The tuyeres were pretty close to the bottom, as but little iron was to be held at a time.

A Sturtevan Fan supplied the air, power being obtained from a small gasoline engine. The cupola was but three feet high above the spout, and was charged without difficulty. When the asbestos charging door was lowered,

the draft was very strong, as the flue in the tower went to the battlement forming the roof of the Castle, some thirty feet high at that point. This flue was three feet in diameter, in the tower of solid concrete, and thus made an excellent cupola stack. The coke bed was brought to red heat quickly, and the iron came out very hot, especially as a high coke ratio is necessary with a small cupola.

The accompanying illustration shows the cupola corner of the little foundry.

The test bars, dumped when cold, were only brushed and then broken transversely on a 5,000 lb. Riehle testing machine as shown in Fig. 3.

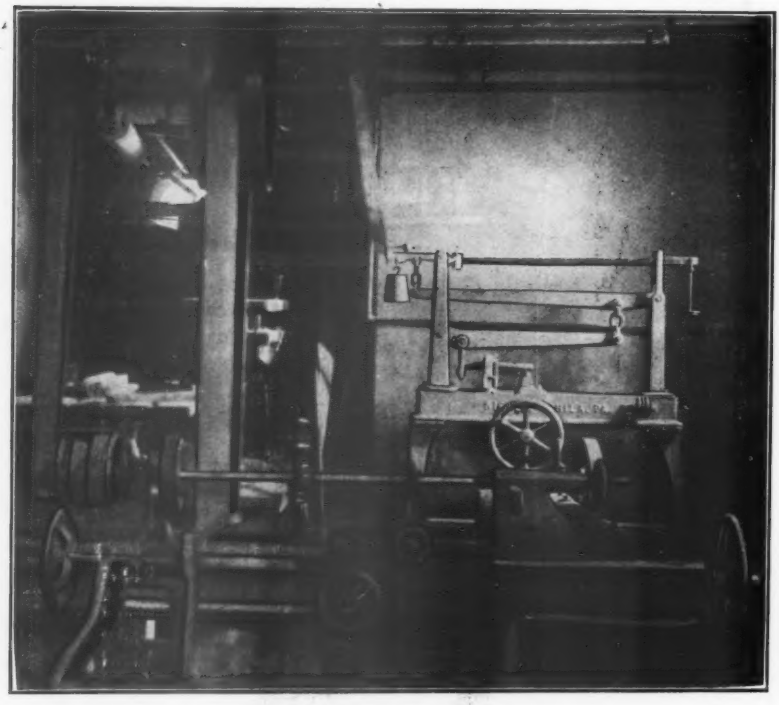

FIG. 3—TESTING MACHINE

The test bars were carefully calipered, results of tests tabulated, and the Modulus of Rupture calculated out. As there were quite a lot of tests, and many of the bars varied slightly in diameter from the standard, making it

difficult to compare effects by glancing over the tables, the breaking weights were all recalculated from the Modulus of Rupture back to the standard 1¼ inches diameter test bar. This while not correct in its strictest sense, for cast iron is not homogeneous and does not follow the rules applicable to steel; is nevertheless perfectly reliable for a very fair comparison in showing the general effects of the alloy addition.

TABLE I

BURNT IRON. GRAY. (Burnt grate bars, stove iron etc.)

No Vanadium added.

No.	Broke at	Deflection	Modulus of Rupture lbs. per sq. inch.
1	1,500 lbs.	.105"	29,410
2	1,380	.100	27,080
3	1,060	.070	20,720
4	1,020	.100	19,020
5	1,600	.085	31,290
Average	1,310	.090	25,500

Analysis of No. 2

Silicon	2.13
Sulphur	.094
Phosphorous	.638
Manganese	.35

0.05 per cent. Vanadium added (lump).

6	2,430 lbs.	.100"	47,550
7	2,200	.100	43,030
8	2,020	.100	39,570
Average	2,220	.100	43,380

Analysis of No. 7

Si	2.03
S	.095
Mn	.37

TABLE II

BURNT IRON. WHITE.

No Vanadium added.

No.	Broke at	Deflection	Modulus of Rupture lbs. per sq. inch
9	1,400 lbs.	.045"	27,480
10	1,480	.050	28,870
11	1,440	.050	28,170
Average	1,440	.050	28,170

Analysis of No. 11

Si	.41
S	.146
P	.423
Mn	.43

0.50 Mn. and 0.05 Vanadium (lump) added.

12	1,740 lbs.	.060"	34,080
13	1,650	.050	32,300
14	1,940	.050	38,070
15	1,940	.050	38,070
16	1,910	.060	37,380
17	1,680	.050	32,840
18	1,880	.050	36,830
19	2,140	.060	41,780
20	1,940	.055	37,930
21	1,780	.065	34,770
22	2,170	.050	42,470
23	2,160	.060	42,190
Average	1,910	.055	37,400

Analysis of No. 16

Mn	0.65

TABLE III

MACHINERY IRON. GRAY. Melted Pig Iron—no scrap.

No Vanadium added.

No.	Broke at	Deflection	Modulus of Rupture lbs. per sq. inch
24	1,980 lbs.	.095"	38,670
25	2,210	.100	43,220
26	2,230	.080	43,550
27	1,660	.120	32,440
28	1,820	.140	35,540
Average	1,980	.105	38,680

Analysis of No. 24

Si	2.72
S	.065
P	.668
Mn	.54

0.05 Vanadium (lump) added.

29	1,970 lbs.	.120"	38,450
30	2,360	.110	46,150
31	1,880	.115	36,850
32	1,960	.090	38,330
33	2,160	.090	42,240
Average	2,070	.105	40,410

0.10 Vanadium (lump) added.

34	2,180 lbs.	.120	42,550
35	2,150	.115	42,080
36	1,730	.105	33,930
37	1,930	.110	37,820
38	1,830	.115	35,810
39	1,990	.120	38,950
40	1,670	.135	32,640
41	2,420	.140	48,380
42	1,900	.125	37,100
43	2,550	.100	42,470
44	2,570	.130	50,250
45	2,280	.120	44,670
46	2,850	.110	55,640
47	1,960	.105	38,250
48	2,050	.105	40,180
49	2,520	.105	49,290
50	2,600	.100	50,850
51	2,280	.100	44,670
52	2,250	.115	43,980
Average	2,200	.115	42,600

0.15 Vanadium (lump) added.

53	2,800 lbs.	.140"	54,800
54	2,940	.115	57,410
55	2,680	.125	52,330
56	2,560	.140	50,070
Average	2,740	.130	53,750

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TABLE III Continued

0.50 Mn. and no Vanadium added.

No.	Broke at	Deflection	Modulus of Rupture lbs. per sq. inch
57	2,070 lbs.	.100"	40,400
58	1,910	.100	37,360
59	1,920	.100	37,470
Average	1,970	.100	38,410

0.05 Vanadium (ground) added

60	1,940 lbs.	.100"	37,930
61	1,980	.100	38,760
62	2,110	.100	41,230
63	1,900	.095	37,110
64	1,970	.100	38,470
Average	1,980	.100	38,700

Anaysis of No. 61

Mn -	.54
V - -	.33

0.50 Mn and 0.05 Vanadium (ground) added.

65	2,210 lbs.	.110"	43,290
66	2,120	.100	41,500
67	2,110	.100	41,230
68	2,100	.100	41,090
Average	2,130	.100	41,780

Analysis of No. 66

Mn -	.66
V - -	.25

0.10 Vanadium (ground) added

69	2,240 lbs.	.090"	43,830
70	2,400	.095	46,810
71	2 500	095	48,770
72	2,410	.090	47,140
73	2,310	.090	45,080
Average	2,372	.090	46,320

Analysis of No. 70

Mn -	.59
V - -	.36

0.50 Mn. and 0.10 Vanadium (ground) added.

74	2,440 lbs.	.110"	47,760
75	2 520	.120	49,340
76	2,640	.120	51,670
Average	2,530	.120	49,590

Analysis of No. 75

Mn -	.59
V - -	.25

0.15 Vanadium (ground) added.

77	2,320 lbs.	.100"	45,350
78	2,330	.100	45,490
79	2,250	.100	43,980
80	2,450	.100	47,960
81	2,430	.100	47,550
Average	2,360	.100	46,070

Analysis of No. 78

Mn -	.56
V - -	.27

TABLE IV.

REMELTED CAR WHEELS, White. No Pig Iron

No Vanadium added

No.	Broke at	Deflection	Modulus of Rupture lbs. per sq. inch	Analysis of No. 82	85
82	1,420 lbs.	.040"	27,760	Si - .60	.53
83	1,550	.050	30,220	S - - .122	.138
84	1,470	.045	28,720	P - .399	374
85	1,710	.050	33,420	Mn - .38	.44
86	1,200	.050	20,390		
Average	1,470	.050	28,100		

0.05 Vanadium (lump) added.

87	2,750 lbs.	.050"	53 750
88	1,880	.050	36,730
89	2,000	.050	39,030
90	1,960	.055	38,340
91	2,350	.050	39,990
Average	2,190	.050	41,570

0.10 Vanadium (lump) added.

92	1,980 lbs.	.050"	38,750
93	2,100	.050	41,090
94	2,040	.040	39,850
95	2,170	.050	42,440
96	2,050	.050	40,090
97	1,910	.040	37,350
98	2,080	.050	40,680
Average	2,050	.050	39,750

0.15 Vanadium (lump) added.

99	2,100 lbs.	.075"	41,090
100	2,300	.050	44,810
101	2,570	.080	50,300
102	2,360	.050	46,180
103	2,020	.055	39,440
104	2,410	.050	47,140
105	2,130	.070	23,570
106	2,220	.060	43,290
Average	2,264	.060	44,480

0.50 Mn and no Vanadium added.

107	3,060 lbs.	.070	59,860
108	2,700	.070	52,840
109	2,590	.070	50,560
110	2,810	.075	55,030
Average	2,790	.070	54,570

TABLE IV Continued.

0.05 Vanadium (ground) added.

111	3,030 lbs.	.060"	59,260
112	3,010	.065	58,860
113	3,020	.060	59,070
114	2,950	.060	57,690
115	3,040	.065	59,460
116	3,060	.060	59,850
Average	3,020	.060	59,030

Analysis of No. 113

Si	.45
S	.096
P	.423
Mn	.40
V	.36

0.50 Mn and 0.05 Vanadium (ground) added.

117	2,980 lbs.	.080"	58,270
118	2,950	.080	57,720
119	3,020	.090	59,090
120	3,090	.090	60,470
121	2,770	.075	54,280
122	2,990	.095	58,410
Average	2,970	.090	58,040

Analysis of No. 117

Si	.66
S	.110
P	.591
Mn	1.15
V	.25

0.10 Vanadium (ground) added.

123	2,870 lbs.	.060"	56,130
124	2,640	.050	51,630
125	2,910	.060	56,910
Average	2,800	.055	54,890

Analysis of No. 123

Si	.45
S	.119
P	.414
Mn	.50
V	.31

.050 Mn and 0.10 Vanadium (ground) added.

126	2,950 lbs.	.090"	57,720
127	3,060	.100	59,780
128	2,970	.100	57,990
129	3,130	.080	61,160
Average	3,030	.090	59,220

Analysis of No. 128

Si	.53
S	.084
P	.431
Mn	.74
V	.27

0.15 Vanadium (ground) added

130	3,460 lbs.	.075"	67,670
131	2,700	.065	52,800
132	2,570	.060	50,260
133	3,040	.070	59,310
134	3,250	.075	63,560
135	2,700	.060	52,800
Average	**2,950**	**.070**	**59,230**

Analysis of No. 133

Si	.42
S	.112
P	.417
Mn	.40
V	.45

TABLE IV Continued.

0.50 Mn 0.15 Vanadium (ground) added.

136	4,020 lbs.	.090"	78,620
137	3,940	.100	77,050
138	3,960	.080	77,440
139	3,860	.080	75,490
140	3,740	.120	73,070
141	4,000	.100	78,230
Average	3,920	.095	76,650

Analysis of No. 137

Si	-	.50
S	-	.081
P	-	.374
Mn	-	.54
V	-	.22

The analyses were for the most part made on bars in which the powdered alloy was used, as these tests were most satisfactory. All tests, however, are given, as they seem to confirm the belief that the addition to the strength of the metal is a well founded one. The vanadium alloy used contained

Vanadium - -	14.67
Carbon - - -	6.36
Silicon - - -	0.18

While the vanadium content is comparatively low, this is a very good alloy for foundry purposes, as cast iron is already high in carbon, and the silicon is too small to cut an appreciable figure in the results.

While the attempt was made to get as nearly 0.05, 0.10, and 0.15 vanadium into the ladles of metal as possible, the analyses show that for the

bars selected (as nearly the average for strength as possible) as much as two or three times actually remained after casting. This is due first to the impossibility of accurately weighing out in the small space of time available to prevent undue cooling of the metal, most of the time dealing with less metal in the ladle than expected or arranged for. Then, with the small quantities tried, the chances for irregular distribution were very great. A foundry with five or ten ton ladles would give a better opportunity. Finally there is the uncertainty of how much or little vanadium is oxidized. The very best results with both manganese and vanadium, show very little of the latter remaining.

The results, however, are sufficient to strongly recommend the new alloy to the consideration of foundrymen. If but a part of the resistance to deterioration found by adding vanadium to steel should be proven by service trials to exist in cast iron, then on the score of safety to human life alone, the metal belongs in every car wheel. A still better method would be to use a more powerful deoxidizer than manganese, and add the vanadium on top of it.

The results shown in the tables speak for themselves, and the averages tallied off for each table shows a remarable progression of values. To increase the breaking strength of a test bar from 2,000 up to 2,500 for gray iron, and 1,500 up to 3,900 for white iron is sufficient to warrant further investigation on the part of every foundryman who has special problems in strength to master, and this part of the investigations is therefore given to the foundry public at this time, rather than to wait for the further tests still on the programme. It is expected to continue the investigations on vanadium in cast ron further, making provision to keep the ladle with melted iron heated up for a fairly long period, so that better mixing of the alloy may result, and hence more accurate results can be obtained.

In conclusion, the writer desires to acknowledge his debt to The Vanadium Alloys Co. for the generous donation of metals, fuel, alloy, and the making of the analyses (through Francis J. Peck & Co., of Cleveland) and a handsome donation toward a testing machine. The writer with the assistance of his men, did the rest.

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OF CIVIL ENGINEERS
NEW YORK.

CURRENT FOUNDRY TOPICS

BY THE SECRETARY

Shop Organization

Our fellow-foundryman Andrew Carnegie, once said that if some great catastrophe should destroy his works, but spare his organization, he might be inconvenienced temporarily, but could depend upon the re-establishment of his business by his organization. Should, however, he lose his organization, even if his mills were left intact, he would not have time and strength enough to get on his feet again. Andrew Carnegie is probably the most conspicuous example of what a first-class organization at the top end of a vast concern can do for one man. What it does for the man at the other end is another story.

A long line of prominent successes and failures in the foundry world, as well as in other branches of the manufacturing and mining industries of this country and Europe, cannot help but make the thinking man look below the surface. He looks for the underlying forces so potent for good or evil and yet so little understood. In the last analysis we have to do with MAN, his strength or weakness of character, his attainments and deficiencies, his characteristics as shown by his intercourse with his fellows, and his temperament and ambitions. Only the man, (or group of men,) who can value these matters properly, and weigh each individual concerned judicially, can hope to build on a firm foundation. The business structure thus erected will be as valuable to the country as to himself.

Perhaps the simplest but least understood of the fundamental factors entering into business and social life is the inherent demand of every man for just treatment by his fellow beings. Building libraries is a good thing, and endowing hospitals still better, but far above these philanthropies would seem to lie the elimination of risk to life and health in our establishments, the removal of irritating influences which breed discontent, the administering of impartial and just treatment from the highest to the humblest employee of a concern, and the constant bearing in mind of "the conscience which recognizes obligation."

Take any of our great and successful establishments, and get into touch with the management, and you will find the universal complaint of disloyalty of the men. See the men, on the other hand, and you will always find the irritation due to arbitrary and unjust treatment, the existence of conditions repugnant to an independent spirit, etc. One need not then wonder why oftentimes the percentage of changes in the shop organization amounts to over 100 per cent. annually. How much greater would have been the success of the business pecuniarily, as well as the prosperity of the community, had more attention been given to the feelings of the actual wage earner.

It is not the establishment of magnificent lavatories, club houses and recreation rooms for employees that are wanted so much, as the ordinary decencies of life in factories, the

absence of petty tyrannies, living facilities which will allow cheerful family life, and the strictest regard for right and wrong in the compensation for actual work done, as well as for ideas presented and adopted.

The writer has known many cases personally where rank injustice was done the men, and their violent disloyalty incurred because the management did not or would not take the trouble to watch the shop officers.

How often has it happened that a pay clerk needing some change simply makes errors in the envelopes, and those affected understand very well that there is little chance for redress, or are too recent arrivals to know better.

How many of our foundrymen have discharged their labor foremen for levying tribute from the crowds of men they put on during the year. How about the presents voluntarily handed over in some places every so often to those in power as tokens of esteem, in perpetuation of a nasty European custom. To those who really are close in touch with the poor emigrant, speaking his language and enjoying his confidence, be it said to the everlasting shame of American Industry, that the revelations of the "Jungle Book" were not new. Unspeakable conditions have been unearthed on occasion when the head or a director of some of our large industrial establishments took the trouble to trace up some vague rumor connected with the treatment of an employee or actually whole departments.

Be it understood that little of the above applies to our skilled labor, for their unions, often established on this very account in former times, would soon put an end to such matters, but rather to the rank and file, whose desire is to locate permanently where they can stay at the lowest living expense. These men, who have plenty of their own faults, must receive a certain amount of training at each shop they go to, and this becomes a source of considerable outlay per annum over and above what the class of labor should be charged with.

Now for a solution: The writer was at one time designated one of a committee of five to run the manufacturing end of a very large establishment during the absence of the head. He represented the Engineering staff, another the financial end, the shop proper had two, and the last represented the principal owner. Questions of policy, manufacture, installation of new apparatus, and the like came up at the weekly meetings. The departments had to work hand in hand, where formerly it was a case of putting the blame up to the next man, and the general feeling throughout that previous "one-man" works was one of relief and fair content. The usual former conditions at once returned when the allotted time for the committee expired.

Others have tried similar methods, and have invariably found them an improvement on the old way. Many establishments now have their superintendents meet regularly, and the result is always a greater output of better material for the establishment. But in spite of all this there is something lacking. This element is the man in the shop. He is not taken into account, and it is this point which has prompted the writing of this article.

Some time ago it was the fortune

of the writer, while on professional business, to observe the working of a very interesting method of "getting together." The shop was fairly large and not far from a great city in the Eastern part of the country. Being the first instance observed by the writer in which men in the shop were represented in committee, an outline of the shop policy will be of interest. First of all a chart of the organization was posted through the shop from which every one could understand his proper place in the line of responsibility. The "Works Committee," composed of one representative elected from each department of the works, acted as the lower house. Elections were arranged so that one man dropped out each month, a new one being chosen. Thus the personnel of the committee changed about once each year, giving many men in the shop a chance to act and become familiar with the work. This committee met once a week at lunch, the latter being furnished by the company.

The "Advisory Board" composed of the superintendent as chairman, and the foremen and heads of departments, acted as the upper house. This committee met daily, informally, at lunch, the coffee only being furnished by the company.

Signed suggestions, collected from the suggestion boxes and copied with the signature taken off, were first discussed by the lower house and then referred to the advisory board with recommendation for adoption or rejection. Finally, after action by this board, they went to the manager with the action of both houses marked on them. Once a month, in the evening, the two houses met for discussion of the general shop policy, the adjustment of special cases, etc., the manager presiding.

The works committee, a real grievance committee, were required to take up the case of every man who considered himself wronged, before it reached the general board, and the result was the righting of every intentional or unintentional unfairness within that shop. Disloyalty was thus overcome in a great measure or at least quickly stamped out by the removal of the offender. The management had installed many "betterments" however, without frills. Stages to transport those living in the great city near by were furnished at cost to the men. Lunch was also provided at cost, and opportunity given to each man to let him feel that he could remain clean and decent if he wished to.

Every new-comer was taken in hand by this shop committee first and the situation explained him. He was told that he would not be accountable for entering a saloon or more of them, but he would be so held for the condition he was in when he came out. He was further told that if he had any complaint or suggestion to make, there was a box in his department provided for that purpose. His complaint, if just, would be righted. His suggestion, if accepted, paid for. Every suggestion, by the way, had to be signed, though treated as before explained. Anonymous communications were not considered.

For each suggestion accepted one dollar was paid. Quarterly five dollars was paid to the one who had the greatest number of suggestions accepted. Three dollars to the next and two to the third. Fifteen dol-

lars was paid the foreman quarterly from whose department the greatest number of adopted suggestions came, and ten dollars to the next foreman.

It will be seen that such a method, the barest outline of which only is given here, takes into consideration the "Justice to everybody" question which should really be the foundation of our system of employment. The system above outlined, by the way, has been devised and introduced in a number of establishments by our friend Mr. H. F. J. Porter, who will doubtless be glad to give further information to those specially interested.

Now a few comments by the writer, who attended as well as took part in one of these general meetings above described. The earnestness of the men was remarkable. They came promptly and stayed late into the night voluntarily for the good of the cause, and while the discussions were at times fierce, the chairman kept things well in hand and business was dispatched quickly and effectively. The fact that the voting was invariable unanimous when through with the discussion showed well for the system. Now the apparent drawbacks as observed by the writer, a stranger to this system: All systems, no matter how well devised, have to do with the human element. Some of the men present at this meeting were carried away by their devotion to the ideals aimed at and therefore expected too much. The millenium is still far away, and they—notably the works committee—found it hard to realize this. Others had their petty jealousies which were bound to crop out. The tendency to put the blame on the other man when it showed itself was quickly discounted by the rest of the assemblage, as a scutiny of the faces revealed. Again a noticeable drift was occasionally manifest of several people getting together before the meeting to play politics as it were. Now such things are always bound to crop up where man meets with his kind. A good judge of men, as the chairman must of necessity be, will always see that no lasting harm is done, or else he will apply the weeding process. Every man, who is placed so that "the consicence which recognizes obligation," (so ably put by our member Mr. Alexander) is held right against him, will either make good or soon be a candidate for another place. By the way, it may be remarked that the manufacturing concern in question from being a nuisance to its community before this system of "get together" was applied, became a factor for good thereafter. The organization was increased 100 per cent. in six months, and sales and profits went up proportionally. It was simply a good example of shop organization on advanced lines. It will pay our foundrymen to do a little thinking along these lines to see if some of the above may not fit their case.

Just a final point. A man, no matter how humble, looks forward to a chance for promotion. If he gets it he remains and becomes a benefit to works and community. If he sees the higher places as they become vacant filled with outsiders, he either leaves or becomes one of the great army of those who look only for pay-day, drink, and worse things. If an establishment is wide enough awake to send out its men to see other places, these men will come back with new ideas and see them

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worked out and applied. If not, the chances are for a vacancy in that works. Presumably in the 20th century, no works having the necessary funds to command will lose its good men to competitors for the lack of internal improvements. Hence there is no danger of good men leaving if treated right. Now by having men in training for the higher positions, new blood will always be available, and only the desire to enter into business for himself will take such a man away. This no honest employer will deny him, in fact his friendship and good will is always given freely.

Now why not carry this out for the very lowest plane of labor in the shop? A system which will start the laborer in the yard at the prevailing rate of wages, with a good yard foreman to pick out desirable types, will furnish a good supply to draw from for the furnaces, molding floor, etc. As the men are taken into the departments give them a slight advance, so that they feel the effects of a promotion. Those outside have something to look forward to. Then when assistant foremen are wanted, give the best man a chance, thus again making a promotion. The men, thus treated in this matter and fairness ruling in other respects, can not be thrown out of such a shop.

The writer carried out this policy himself at one time. Men coming with letters which could not well be denied were given the choice between no job or one as common laborer. An eye was kept on those who stuck, and a number of well paid foremen now are a credit to their respective organizations. All the others, who could not stand the test, fell by the way.

Foundrymen — think of these things a little, and let the "conscience which recognizes obligation" act. It will pay you.

REVIEWS

Distribution of Sulphur in Ingot Molds.

Centralblatt d. Huetten U. Walzwerke. 1907. page 499. abstracts the paper by Mr. J. Henderson, recently read before the Iron & Steel Institute. While it is well known that the bulk of the sulphur is found in the top portions of the Ingot Mold, it is nevertheless incorrect to assume that the rest of the casting is just as bad, and hence reject the ingot mold as stock for steel making. Here are the results obtained for the sulphur in top and bottom of rather high sulphur ingot molds. Top, respectively .206, .083, .075, .226; and bottom .034, .032, .031, .058, all but the last ingot mold being made of pig iron having a maximum of .030 sulphur.

Another method takes equal portions of borings from top and bottom of an ingot mold to determine the sulphur, thus getting the average. This assumes that the sulphur increases from bottom to top evenly. This is not the case as the following results will show. A hole was bored into an ingot mold from the top downwards to a depth of eight inches, and an analysis of every inch

depth taken. In addition an analysis of the first half inch was made. The figures ran as follows:—half an inch down .190, one inch down .142, 2 inches down, .082, next .055, .047, .045, .041 .041, .042. Combined carbon half an inch down .29, and then .41 all the rest of the way. Similaly manganese began with 1.12 and then ran 1.06 to .95, while silicon ran from 1.21 to 1.26 all through, and phosphorus .042 to .044.

Next a hole was bored into the face of the mold to a depth of 6 inches and the sulphur as taken gave .072, .057, .047, .044, .043, .044. All of which shows that the bulk of the sulphur is to be found up to a depth of one inch, and that beyond two inches the material can be classed as good. A further peculiarity is the fact that the highest sulphur goes with the lowest combined carbon, which is contrary to our experience. This may be explained by the higher manganese, a sulphite of manganese evidently being formed. The castings from which these results were obtained were seven feet long and weighed four and three quarter tons.

Cupolas with and without Forehearth.

Giessereizeitung No. 16.—Engineer Kloss of Frankfort, Germany, presents some data on cupola practice which may interest us. He divides cupolas into two classes:—Those with direct air blast, and those into which the air is drawn by means of a steam jet in the stack. The latter are quite limited in number, and used only in cities and where there is danger from fire through sparks. The regular shaft cupolas are again sub-divided into those with a fore-hearth attached and the style we are accustomed to.

In recent years, states Mr. Kloss, the forehearth type of cupola is being used more and more, and not always with good judgment. It cannot be denied that the metal made is rather colder than that from the plain shaft cupola. The cold walls of the forehearth are bound to do this, and metal intended for very light work would have to be poured out. It is oftentimes necessary to preheat the forehearth with a charcoal fire, and this means added cost in production.

On the other hand the advantages of the forehearth are so great in regard to the effectual mixing of the metal that much can be forgiven it. Greater bodies can be collected. There is less trouble with the cupola itself. Less attention need be given the tuyeres, etc. The straight shaft cupola can be provided with a large bull ladle and thus gather a lot of metal also, and if preheated will hold the temperature as well as the forehearth. However, the attendance on the cupola is exacting, and troubles with the tuyers are liable to occur. Outside of this, however, especially if the iron is taken away fast by means of a crane, the temperature of the metal is apt to be higher than is the case with a forehearth, and its advantages are not as great as generally supposed.

Production of Molding Sand.

U. S. Geological Survey.—In the "Mineral Resources of the U. S." recently published, the production of molding sand in this country is given at 3,375,000 tons, valued at a little over two million dollars.

Care of Cast Iron Core Boxes.

The Brass World. Sept.—Cast iron for core boxes is ahead of "good pattern bronze" for in wearing qualities cast iron cannot be beat. Bronze, unless very hard will become distorted by constant hammering and handling, and only a slight deviation will cause the boxes to stick. Core boxes of iron will rust if not properly treated and hence after the boxes are made they should be heated and have paraffin rubbed over the surface.

This will fill the pores of the iron and give a protective coating. Repeat this process occasionally, and

the older the boxes become, provided they are not allowed to pit and rust, the better this coating becomes, gradually turning into a black oxide of iron and preventing the sticking of the core. The combination of this oxide with the paraffin is most desirable.

Molding Sand.

The Foundry Trade Jounal, No. 68 In a paper on the precepts and practices of foundry work, Mr. Robert Buchanan touches on molding sand. We take the following from his remarks:

"Sand is made up of silica, which has no adhesion between its particles, and is infusible. The other ingredient for the molding varieties has clay for the bond. The amount of this clay runs between 4 and 14 per cent. When higher, as for loam work, it requires special drying. When lime is present in quantity the sand will fuse and give trouble, especially with core work. The amount of cohesive matter should be limited to that which will allow good ramming up without destroying the porosity of the material, so that gases may pass through rapidly but iron may not penetrate. The addition of facing in shape of sea-coal, etc. is intended to allow the formation of a coating of solid carbon between the sand and the casting. The carbon deposits either from the hydrocarbons driven off the sea-coal, or graphite can be used direct." Mr. Buchanan gives several analyses of molding sand, as follows:—Silica: 87.86 to 94.02 Alumina: 3.73 to 5.04, Oxide of iron: 2.07 to 4.28; Lime 0. to 0.30; Moisture; 0. to 2.41. A rational analysis giving the sand, clay substance, etc. would have been more valuable to us.

German Pig Iron Classification.

Transaction, German Foundrymen's Association. The Reinish Westphalian Pig Iron Syndicate (Trust) has classified its iron as follows, grading by fracture being entirely obviated and chemical analysis ruling:

Brand	Silicon	Manganese	Phosphorus	Sulphur
Foundry No. 1	not under	not under	not over	not over
	2.5	1.0	0.6	.04
Foundry No. 3				
a) Rheinish-Westphalian	1.8-2.5	below 1.0	below 0.9	.06
b) Siegerland	1.8-2.5	0.8-1.25	0.6-0.9	.05
Hematite Pig	2.0-3.0	not over 1.3	not over 0.1	.04
Lorrain Pig No. 3	about 2.4	0.5	1.8	.05
" " No. 4	" 2.2	0.5	1.8	.05
" " No. 5	" 2.0	0.5	1.8	.05

Pig Iron Specifications and Samplings in England.

The Foundry Trade Journal, No. 64.—Mr. H. Pilkington states that "Buyers by analysis are so rare and so varied in their requirements that they are practically a negligable quantity." Further on he says "Grade and grain are the matters of greatest importance in the iron trade." Again: "It must be admitted that fracture in itself is not a reliable guide to the composition of the metal, and some improved method of grading is desirable." All of which must make us feel that if the above is representative of the great British foundry industry, that we are several years ahead over here. We went through this at the time of the Buffalo Exposition. Today nearly every body is buying by analysis here, and hence it would be use-

less to review the paper in question at length. Our British friends are evidently not quite ready yet, but will get there just as surely as we did. In the discussion of the address in question, Mr. Parker stated that he had never had trouble in making his pig iron so far as the fracture was concerned, unless in casting it they threw on water to cool it quickly in order to make room for the next cast. To get uniform results he thought it would be necessary to use a mixer before the metal was cast into pigs. Mr. Walker stated that he had had so much misrepresentation on the part of the salesmen that he expected to go to buying by analysis soon. Mr. Shaw said that he was much impressed by the fact that the American buyers get analyses even of British irons. Why could not they get this if the Yankees did? Mr. Buchanan called attention to the fact that in his district when a blast furnace man was told to give an analysis or lose the order, he felt "very wroth on the suggestion" but gave in if he could not make the deal otherwise.

Cupola Practice and Design.

The Foundry Trade Journal, No. 64.—Mr. G. G. Ure, after studying British and American Cupolas, concluded that there is still room for improvment. In building his cupola he selected a diameter of 78 inches and lined it up with 18 inches of brick, so that he got about 39 inches inside diameter for the start, and left himself room for future expansion. The wind belt he made 40 per cent. larger than the combined tuyere area to obviate the fluctuations of the blast pressure. The blast pipe he also made 40 per cent. larger than the blower outlet. In arranging for the tuyeres, Mr. Ure put in two rows, the lower to do the work, and the upper to experiment with, to see if the "theorists" were right. He found they were wrong, and discarded the upper row after a while. The lower row of tuyeres were made 18 per cent. greater in area than the blower outlet at the back end which was square, and twice as large but flat and wide at the front. Instead of letting a line through each tuyere pass through the center of the cupola, Mr. Ure ran his blast direction at a tangent. The lower tuyeres were 14 inches above the sand bottom. The charging door four feet above the lower tuyeres, and the platform level with the charging door, so that material could be dropped in directly. The stack was made larger in diameter than the cupola body "to lessen the force of the escaping gases and leave sparks fall back inside," but, thinks Mr. Ure, a spark arrester is still better. Mr. Ure adopted the drop bottom "against most friendly advice" and now appreciates the American plan. He states that there are some 20 foundries in his district, some with more than one cupola, and only two of them use the drop bottom. The drop bottom was tried at one of these foundries and ordered out as unsatisfactory, (which shows the urgent need of the British Foundrymen's Association).

In lining up it is important to get the grouting of as good material as the brick or blocks used. The brick is dipped and laid very close. Mr. Ure allows ¾ to 1 inch between the shell and the lining, and packs this full of coke dross or molding sand. Around the tuyeres he makes a solid job by the use of asbestos packing. A pressure blower was used, set at ¾ lbs. for the blast, Mr. Ure, having no experince with fans. He, however, thinks them good. His melting ratio is 1 to 11. not counting the coke bed, which unfortunately does not tell the story.

Failure of Iron Castings in Service.

American Society for Testing Materials.—In a paper before this body, Mr. Robert Job took up some of the causes of failure of iron castings in service. The first cause is unintelligent mixing, thus getting the wrong metal for the work intended. With the increasing use of chemistry in

the foundry, this is bound to get better, though there are inherent difficulties to be contended with, such as irregularities in shipment, carelessness, etc. The result is failure in service. Examples of these irregularities are well known. Thus the same car contained 0.8 to 1.5 per cent. phosphorous, while another had the silicon run all the way from 2.00 to 5.00 per cent.

The failure to get the proper composition in the pig iron used, may be intensified by running the wrong kind of iron into important castings. Locomotive cylinders and wheel centres which failed within a short time, on investigation were found to run nearly one per cent. in phosphorous, and 2.5 per cent. silicon, and hence weak under the impact of service conditions.

To overcome this condition the laboratory of the rail road interested made a special study of the foundry and regulated the iron and coke very carefully, thus overcoming most of the trouble. The machine shop got over difficulties with hard and spongy iron, the mixture was cheapened, and clean, better castings produced. Mr. Job then describes some of his researches on the burning of iron in the cupola and attributes much of the trouble from porous castings to this, in which he is entirely correct.

Some New Steel Foundries.

Iron and Coal Trades Review. In the U. S. the open hearth furnace undoubtedly has the commanding position in turning out steel castings. In Germany the small converter seems to be favored most, while in England no one process has been largely adopted. It seems that with us the small converter process is not profitable unless the daily capacity is at least 10 tons. In Germany a smaller capacity has proven profitable. It seems that the blast used for the small converter has much to do with the efficacy of the process. A Mr. Uckenbolt, of Germany has gone into this matter carefully, finding steel foundries using all the way from 7 to 40 lbs. pressure, the cubic feet of free air per minute used being 3,500 to 10,500. As undoubtedly there was much waste in this, careful experiments were conducted to determine the proper amount of air required, and 1,400 per minute was found sufficient for the purpose, the blowing period being 15 to 20 minutes. A second test made at Krupp's took 2,100 cu. ft. per minute, and did equally well. Of course it makes a difference whether the air is applied bottom up through the molten metal or through the sides just below the top of the bath. Or over the bath blowing across the surface. A fourth method is to blow down upon the bath at an angle.

The 20 ton open hearth furnace seems to be the standard in the U. S. for steel casting work. Mr. Carr describes a 1 to 1½ ton open hearth furnace, used in Russia, which makes 2 to 3 heats in 24 hours, and alternating between making malleable, cast iron, and steel heats, Further, an open hearth tilting furnace, of five sons capacity is described, which uses crude oil and makes a heat in four hours with 45 gals. of oil per ton of steel for fuel consumption. An important factor in this furnace is the ability to remove the port ends, which allows a quick replacement of damaged ends for new ones.

Desulphurization of Iron in the Cupola.

Giesserei-Zeitung, No. 17. Dr. Eckwalt gives a series of data obtained from his experiments on the desulphurization of iron during the cupola melting process. The iron used ran 3.19 in silicon, 0.23 in manganese, and 0.102 in sulphur, and hence was well adapted for such a test. The following experiments were made:—1) Melting iron direct without any fluxes. 2) Melting iron with limestone as a flux. 3) ditto with limestone and manganese ore as fluxes. 3) ditto with limestone and spiegeleisen (25 per cent. Mn).

The quantities used were 1,000 lbs. iron and 100 lbs. coke. Melting the iron alone gave an absorption of sulphur to an extent that the castings showed .205 S. When limestone alone was added (51 per cent. CaO) the sulphur was raised from .102 to .182, showing that half of the sulphur coming from the coke went into the iron. Repeated tests with varying proportions of limestone gave the same results, showing that it was not necessary to increase the percentage of limestone over 2 per cent.

Test No. 3, in which limestone and manganese ore were used gave sulphur 0.161 for the first test with 0.102, and 0.102 for two other trials, in which the percentage of limestone and manganese ore were raised. The results further show that 3 per cent. limestone and 2 per cent. manganese ore took care of the entire sulphur of the coke. Further additions of manganese ore did no more good, as it went into the slag and increased its bulk.

Series 4, in which limestone and spiegel with 25 per cent. manganese was used, gave 0.132, 0.112 and 0.072 sulphur, the last named amount with 3-⅓ per cent. spiegel and 2 per cent. limestone.

The conclusions derived from these tests are that desulphurization should only be resorted to in extreme cases, and that this occurs whether the spiegel was added in the cupola, the ladle, or even as the metal was poured into the mold. It is well to let the ladle stand as long as possible to let the sulphite of manganese formed rise. Further never to desulphurize where a piece is to be machined on account of the hard spots formed. The sulphur in many cases is three times as high in the top of a casting as in the bottom.

Some Physical Characteristics of Cast Iron.

Transactions Engineers Soc. Philadelphia.—Mr. James Chrystie divides castings into three grades No. 1, or light — with 2.5 to 3.0 silicon; No. 2, or medium, with 2.0 to 2.5 silicon; and No. 3. or heavy, with 1.5 to 2.0 silicon. All grades carry about 3.5 total carbon. The recent specifications of the American Society for testing Materials call for 18.000; 21,000; and 24,000 lbs. per sq. in. respectively tensile strength for a 1¼ in. diameter bar turned down. For transverse tests, 2,500; 2,900 and 3,300 lbs. with a deflection of 0.1 inches is required for the three classes respectively, supports being 12 inches apart. While the specifications in question aim to keep the standard of castings high, yet it is well known that there are lots of castings that fall quite short of these requirements. Mr. Chrystie, in his professional use of cast iron assumes a tensile strength of 16.000 lbs. per sq. in. for ordinary castings, and limits the actual working stresses these castings are to be subjected to, to 2,000 to 4.000 lbs. per sq. in.

The compressive strength of cast iron may be assumed to be six times that of the tensile, or say 95,000 lbs. per sq. in. of section. The Modulus of Elasticity in computations where direct tension or compression is involved, may be taken at 13,000,000 lbs. While for bending load applied transversely an average of 16,000,000 lbs. may be used with the ordinary formulae for flexure.

In former times cast iron columns and beams were much used, and experiments were conducted to get at the proper design. Hodgkin and Fairbanks in England, contrived to bring out many facts in this connection. Seeking the beam which would show the greatest strength in proportion to its area of cross-section, Hodgkin designed a section in which the tension flange would exceed the compression flange about 6 to 1 in sectional area. This form of beam became the standard during the time such beams were used.

Machine designers group all the metal about the parts under tensile strains, and leave the compressive strains much lighter provided for in proportion, consequently failures

often take place because the sections are too light.

Cast iron is such a peculiar material, that the ordinary formulae for a uniform material will not apply safely, and hence other moduli must be introduced into the calculations to off-set this. Hence it is well to keep a record of failures and learn from these just what to do. It is well known that a load suddenly applied produces a deflection double that of a slow application. Where the loads are applied rapidly, it will be seen that vibration must result. It is therefore necessary to construct stiff enough to avoid this tendency toward excessive vibration. The limit of deflection should therefore be kept down usually to the 1–2500 part of the span. Sometimes it should be even less.

Where strains are rapidly alternating something more than the greatest strain in one direction must be provided for, and as the elasticity of cast iron is about half that of steel or wrought iron, the tensile stress per sq. in. of section should be lowered to 4,000 lbs under the most favorable circumstances; 3,000 to where the loads are suddenly applied; and 2,000 where these forces alternate in direction. The sum of the deflections should be kept below 1–2500 of the span. This will give sufficient stiffness for all purposes.

The Solidification of Cast Iron.

Transactions of the British Foundrymen's Association. 1907. In a paper on the above subject read by Mr. E. L. Rhead, he states that we now know that the chemical composition of the iron used, and its treatment determine the value of the casting. The part played by each element and the relation of these to each other as far as the end result is concerned, is still a matter to be solved. This is more especially true in the physical sense. Molten iron in setting has a tendency to crystallize. Just how this occurs depends upon many things. The condition of the mold will determine whether the iron cools uniformly, whether it will be full of shrinkage strains and other sources of weakness. While crystallization will vary accordingly as modifications enter due to accident or design, yet it is an inherent property of the metal, which when conditions of cooling are the same, always manifest themselves in the same manner.

The properties of crystallized bodies differ from those of substances that are amorphous. The same body, if differently crystalized, exhibits different properties. Even all parts of the same crystal do not have the same properties, some parts being hard, and others less so. This is due to the manner in which the particles are arranged. It is not necessary that bodies should have a crystalline form, to exhibit the results expected, provided that the substance has been subjected to the conditions which would have produced the crystal if there had been sufficient room available. A perfect crystal is only produced if surrounded by liquid. If a fused body is chilled, and thus cooled rapidly, no arrangement of the particles is possible, and hence there are no crystals.

It is well known in the setting of iron, that the crystals arrange themselves at right angles to the cooling surface. When molten material enters a mold, as it touches the surface a solid crust of metal forms. This is thin at first and thickens as heat is lost. The inner surface, next to the still liquid metal, is rough through the forming of crystals.

How far this will go depends upon the rate of cooling. The thicker the crust the quicker the action, as the solid metal can transmit the heat more readily this way.

Cast Iron is a very composite material. Whatever may be the condition of the silicon, manganese, sulphur, phosphorous, and carbon, they are all dissolved in the iron forming the bulk of the metal. If this were not the case, these compounds would separate out in layers according to their varying specific

gravity. Now the amount of these compounds which can be thus dissolved depends upon the temperature. The higher this is, the more dissolved. On the other hand, the lower the temperature gets, the more of the dissolved compounds are thrown out, or solidified. Recent investigations have shown that this solution and precipitation will take place in the solid state (a fact known for many years in the case of the malleable casting). Iron, which forms the bulk of the material making up a casting, contracts and solidifies. The carbon in the combined state, or carbide of iron, does not interfere with this contraction, in fact the more combined carbon, the greater the contraction. If this carbon, however, is precipitated during the progress of solidification, the graphite being less dense, it takes more space, and the increased volume resulting may occasionally exceed the contraction of the iron at its moment of set. This accounts for the expansion and the fact that the metal is lighter in the solid than in the liquid state.

In ordinary castings it is well known that the heavier contract less than the lighter ones. This is partly due to the slower cooling. As the metal cools it attaches itself to the existing crystals. These crystals project into the molten iron. As long as a channel exists between the crystals, metal will be drawn in to fill the spaces, and fresh layers will be deposited on the sides of the crystals. It the metal is cut off, cavities will form, the sides of which are lined with trees of crystals.

When holes are found filled with gasses, these have been formed originally by inability on the part of the molten metal to be drawn in. Keeping the metal hot locally has a tendency to do this, and hence it is well to distribute the metal in several gates as it is poured, to keep the metal of a more uniform temperature. Using only one gate has the tendency to keep the mold around the gate hotter than the rest of it, and the iron cools there more slowly than at the other portions of the mold. The cracking of plates and other castings is often due to the strains resulting from the withdrawal of metal from the part that cracked, to go elsewhere. The cracks take place at the centre of intersecting lines in the angles of the castings, due to the solidification of the metal between the crystals.

FROM COMMITTEE ON INDUSTRIAL EDUCATION

By PAUL KREUZPOINTNER, Chairman, Altoona, Pa.

There is an old saying that the longest way around is the shortest way home. This is true in the case of modern industrial education where the school and the industries must work together to accomplish something permanent and valuable. However sometimes we are in a hurry and if there should be a fire in our home we do not stop long to select our road but cut across lots and jump over fences to get there. and so the foun lryman who is hard up for clever boys and skillful molders would like to get them quickly.

To get clever boys into the foundry is not so easy, and the next best thing to do is to train our boys as best we can. Efforts in that direction are liable to be received with suspicion. Either it is looked upon as an attempt to get more money out of the boy, or else it is resented as an interference with one's personal rights to do as one pleases.

Now there is a tender chord in the boy, only it is difficult to discover because it is overlaid with a crust of foolish notions and inexperience. But if we dig through that crust

patiently and with perseverance we find a good deal of pride and responsibility in that boy or in any boy.

Above all he is, as a rule, willing to do something for his country and if we do not succeed in reaching the boy's consciousness by appealing to his sense of duty as an employee, the tangible end of which appeals to him only on pay day, we are likely to get him to see that he owes something to his country by being a good citizen through his workmanship and knowledge of things. There is where we often may find the longest way round the shortest way home.

Supposing the proprietors of local foundries put their heads together, and invite the heads of other industries to join, the educational interests being identical with all industries, and arrange with a local Y. M. C. A. or high school to have a "picture show" of the Lake Superior Region, of Montana, Arizona, etc., that is of such sections of our country where our raw material are found, as, coal, lumber, ores, etc.

Get your boys and their chums, outsiders they may be, and men too, to go to the show. Perhaps a moving picture establishment could be induced to lend its aid. Then some professor or other person could be found to explain the pictures and judiciously sandwich into the talk how we, how the foundries—all industries, depend for their existence, for their continuous work and power of employment, upon these raw materials. How the country depends upon them and how we are obliged to use them judiciously if we want to have the United States a strong powerful, prosperous nation.

That would be a starter, a foundation to build upon. Get to the boys' consciousness through his eyes. Then, afterwards, if the boy or man happens to make a botch of something, carelessly or ignorantly, do not let the foreman, or someone else bark at him before all the others, but quietly call his attention to the fact that, aside from the immediate loss, a multiplication of that loss in time and material in all the shops of the country means a waste of our resources, a diminishing of these resources sooner than is necessary. That it means increase in cost of production, of fuel, of sand, of iron, etc. and that means fewer people being able to buy the goods if they cost more, which again means less work and lower wages Then the influence of foreign competition might also be touched upon. There are very few boys so dull or so indifferent that something of this kind of friendly talk would not stick and cause comment among the men and boys. Once or twice during the week devote half an hour to let the boys make some simple calculations in connection with their work, the cost of pig iron for a day, a week, a month or year. The cost of transportation of that iron to the works, of sand, etc. Cost of tools, what the tools are made of. To give them an inkling of the connection of their work and its results with the outside world could be accomplished by letting the boys and shopmen know in what manner they can help to make their industry more prosperous through schools and social institutions; what part the citizen takes in the advancement of common interests of every day life. The advantages of life under a republican form of government as far as it affects the workingman might also be

brought up. Some legal instructions about the way factories are governed by law, accident insurance and first aid in accidents would interest the boys and young men and broaden their views.

Wherever there is manual training in the schools of a city where foundries are located, the foundrymen and other industries combined ought to bring pressure to bear upon the school people to use part of the time now used exclusively for hand work, for the teaching of those things which prepare the boys for vocational life.

Especially the eighth or grammar grade would be suitable for that. A drawback to our young people is their lack of command of good English and composition, letter writing to friends, advertisements, contracts, little essays about their work in the school, petitions, etc. would be of great value to the young people when they go into shop, store or office. Calculations of the work they have in hand, multiplied many times in the shape of a contract, profit or loss on that contract and other matter of a business nature would compensate in advantage, when the boy goes into practical life, for the time lost in purely manual work and dexterity. When he goes into a shop it will not take long for the American boy to acquire manual dexterity, but the technical matter which makes him a more valuable man and citizen, to himself, the community, and his employer, he cannot gain without the school.

Let conferences be called of representatives of foundries and other local industries and the school authorities to discuss to what extent the school and the industries can co-operate. As a rule the school people will be found glad and willing to help. If, in such cases, the chairman of committee on industrial education of the Foundrymen's Association can assist in making out a program or along similar lines he will be glad to do so. While all the above suggestions are at best only temporary makeshifts, until we get a system of separate vocational schools, yet with judicious management much good can be derived from it for the foundrymen.

There is a bill now before Congress, introduced by Hon. Charles R. Davis of Minnesota, entitled as follows: "A bill to provide an annual appropriation for industrial education in agricultural high schools and in city high schools and for branch agricultural experiment stations, and regulating the expenditure thereof."

TEXT OF BILL

By the provision of this act it is intended to promote technical secondary education in agriculture, mechanic arts and home economics.

In its scope this bill is similar to the land grant act, introduced in the house by Mr. Morrill, in 1857 and passed and approved by President Lincoln July 2d, 1862. That bill laid the foundation for industrial education and revolutionized the system of higher education in this country.

The sixty-five institutions which have been organized under the two Morrill acts, of July 2d, 1862 and August 30th, 1890 have been the means of giving either a technical or agricultural college education to some 50,000 graduates since their inception, contributing a large share of trained intelligence and practical

knowledge to help in the upbuilding of our country.

Considering the economic and educational conditions which are pressing with increasing intensity upon our industrial, agricultural and social life, there can hardly be any question that the Davis bill, now before Congress would be similarly beneficial to our country as the two Morrill bills have been.

The difference in the purport of the bill lies in the fact that the Morrill bills fostered the development of college education, gave an incentive to higher education which was badly needed at that time, owing to the then need for trained minds to take hold of the rapidly accumulating discoveries in chemical and physical science and mechanics, for which the second half of the last century is noted, and to turn these discoveries to advantage for our industrial and agricultural development.

Since then our system of college and university education has been extended and perfected to such a degree that it is recognized to be equal to and in some respects superior to European higher education.

However, for the proper and efficient carrying on of our industries and agriculture it is no longer sufficient to have trained leaders only. In 1870 France was defeated by Germany because, while the French army was led by a few superior leaders, the soldiers and subordinate officers, composing that army were woefully lacking in mental and physical equipment to comprehend the situation, to grasp the import of the orders of their superiors and the mere brute force and physical courage of the individual soldier failed to make up for the lack of that mental training, that foresight and careful deliberateness, based upon scientific and technical knowledge of the art of warfare which characterized the German army, its soldiers and subordinate officers.

Exactly the same phenomena, the same defeat, due to lack of proper technical and scientific training of the mass of the soldiers of the Russian Empire was witnessed in the late Russia-Japanese war in an even more aggravated form and with more disastrous results. If the officers of a company of Japanese soldiers fell the non-commissioned officers were competent to take their places; when these also fell there was no panic, no hesitancy, no standing still and be shot down like a flock of scared sheep of the soldiers remaining; they knew what to do in that case and acted accordingly.

And we in the United States are today in a similar condition concerning industrial and agricultural education, or rather lack of education, of the masses of our industrial and agricultural workers, the soldiers, composing the armies, with which the industrial warfare of to-day is carried on and has to be carried on in the future with increasing severity and therefore better training.

And the Davis bill, raising and appropriating a per capita tax of ten cents for the purpose of establishing high schools in the cities and country where the masses of our industrial and agricultural workers are to acquire that training which is not as high, and does not need to be as high, as a college training, but in regard to the mastery of technical and scientific knowledge, now indispensible for the successful carying on of our industries, commerce and agriculture, must be decidedly higher than what we are now offering in our elementary schools, manual

training schools, classical high schools and most of our manual training high schools if we are to hold our commanding industrial and commercial position for any length of time.

There is good reason to believe that in the same proportion as the Morrill bills helped to extend technical and agricultural college education, to the same extent will the Davis bill help to extend that kind of high school education which shall favor the industries and agriculture as the classical high school of the present favors literary pursuits and the professions.

There is a conflict now within the inner life of the present high school due to the encroachment of our industrial necessities upon the facilities and organization of the high school for technical and scientific and commercial instruction, when these facilities and organizations were created and designed only for literary purposes. Thus the modern high school in all but the largest cities has to serve three masters, or interests, where the organization was created for only one purpose, viz. the literary education for the professions, and as a consequence the powers of the high school are divided; a house that was originally built to accommodate only one family has now to accommodate frequently three and sometimes even four families, each of which require different accommodations, different methods of accomplishing the desired end and aim, and as a consequence they are in each other's way more or less. Since much of the work has to be done with the same facilities which are not always suitable for the needs of all the three or four families, there is unavoidable pedagogic friction, loss of time, weakening of forces and neither the classical, nor the scientific, nor the commercial or industrial course of the modern high school gets full attention, acquires that efficiency which the present and future necessities of our country require. Hence a separation of the high school into two schools, each with a distinct sphere of intellectual influence and lines of work, to conform to the literary and industrial needs, according to their respective importance, has become an economic and pedagogic necessity and the Davis bill would go a great ways to meet this urgent necessity. The field of industrial education is becoming so large, its influence upon national life so important, that the classical or literary high school as we know it, is no longer able to do justice to both, and as a consequence these vital branches of our education suffer to the detriment of all interests.

XUM

CORRESPONDENCE

Shop Organization

The subjoined letter from Mr. H. F. J. Porter will interest our members in connection with the recent article by the Secretary on Shop Organization. (See page 197 of the Transactions)

It will be of further interest both to the membership and Mr. Porter to know that many requests for additional copies of the article in question have been called for, showing that widespread interest was aroused by the peculiarly practical way in which Mr. Porter has attempted to solve a problem as old as the world, so far as this may be solved at all.

H. F. J. PORTER, M. E.
INDUSTRIAL ENGINEER
1 MADISON AVE., NEW YORK

May 16, 1908

Dr. Richard Moldenke,
Sec. American Foundrymen's Association,
Watchung, N. J.

My dear Sir:

I am just in receipt of the proof sheets of that part of your transactions covering your editorial remarks on 'Shop Organization" in which you describe the working of a system of management introduced by me in a shop which was very much run down and which I had been asked to reorganize. I presume from the tenor of your remarks that you were present only at one of the meetings of "The Council" composed of the members of both the Works Committee and the Advisory Board, which was held once a month to discuss matters of interest common to both employer and employee and questions of general policy of management.

It is difficult for a perfect stranger to the system to fully realize the function of this latter gathering, or to understand its true value. It was in fact a clearing house for complaints. It offered the opportunity for all hands to bring up any matters which were causing trouble. It was the monthly "wash-day" and everybody was asked to bring here anything which he felt was a source of ill-feeling or every case of alleged unfair treatment, so that all such matters could be thoroughly investigated and cleaned up and the feeling perpetuated throughout the organization that both sides were giving and receiving a square deal.

You say that you noticed that the votes were always unanimous; that was because care was always taken to have every question thoroughly discussed till every one was satisfied that the action proposed was the best that could be devised.

In this way every month there was an outlet offered for pent-up feelings, but there was at the same time being gradually developed a better understanding for both sides, of the others' point of view, and each became convinced that the other in his own way was making the effort to work for the common interest of both.

One of the best evidences of a change for the better in the character of the working force was the growth of permanency in its personnel.

Before the effort at reorganization was begun the works had the reputation of being a "mean shop," and

it was with difficulty that good men could be secured to work there. The organization consisted of floaters. There had been a change of 20 per cent per month, 240 per cent per year in the working force for a long time. This loss was gradually lowered to 15 per cent, then to 12 per cent, then to 10 per cent and 8 per cent, while the organization doubled in numbers. The stringent rule against drinking had much to do with this improvement and this rule was proposed and enforced by the men themselves, who took an ever increasing pride in their organization.

It was the better class of workmen, together with the improved conditions and methods introduced, which made the place pay. I am very glad you had an opportunity to see the system at work and to know that it impressed you favorably even to the cleaning-up process. It is the best cure for so-called labor troubles I know of.

Very truly yours,

H. F. J. PORTER

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